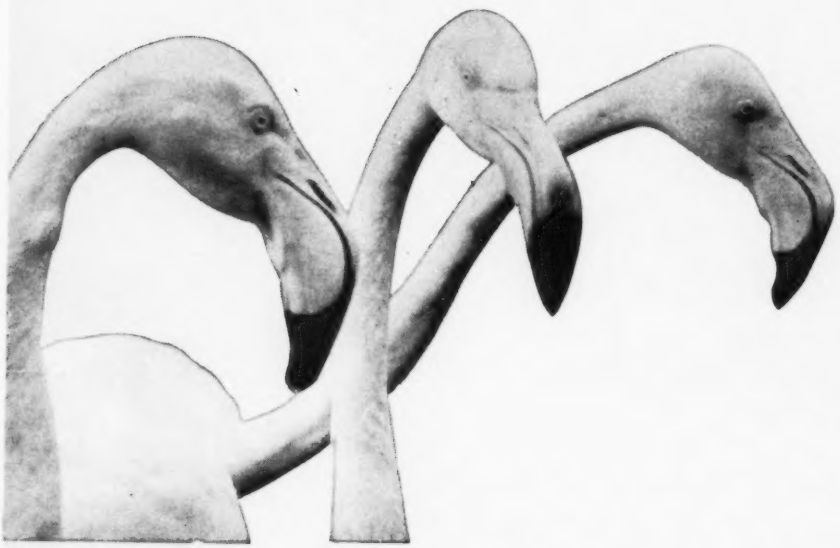
25 DECEMBER 1959

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS



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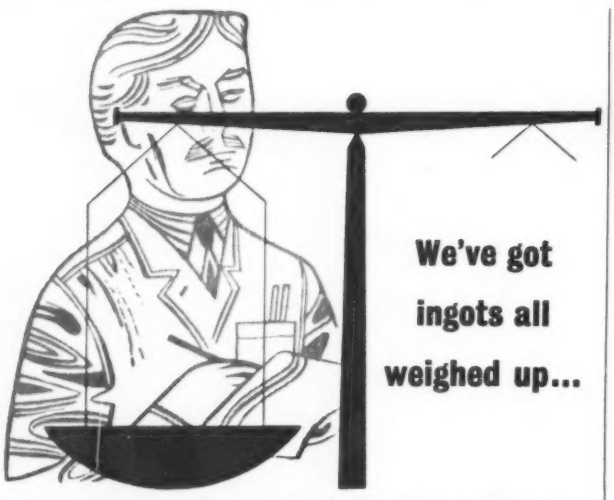

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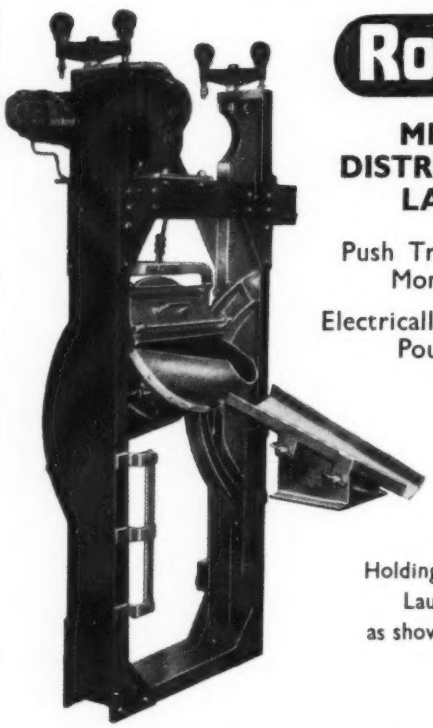

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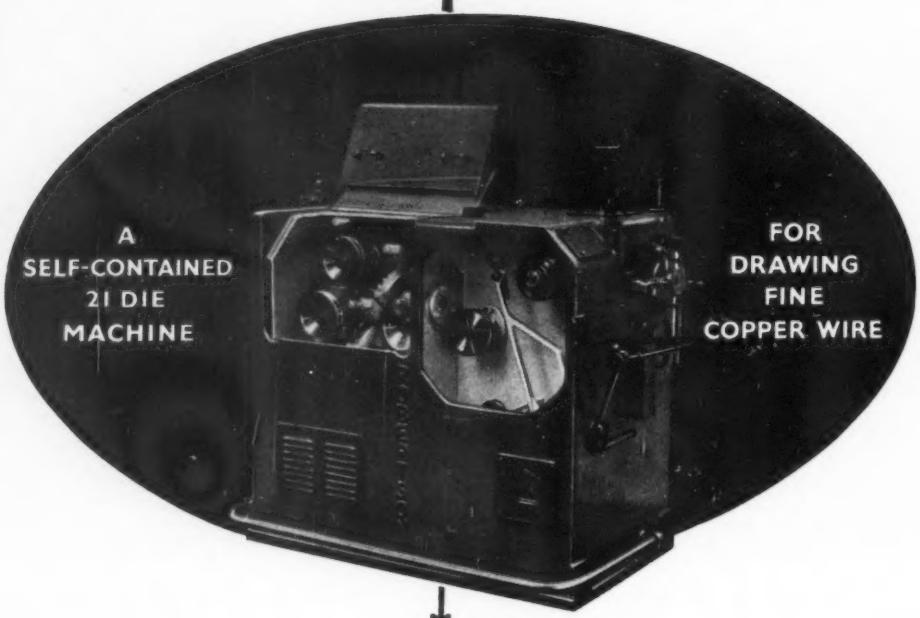

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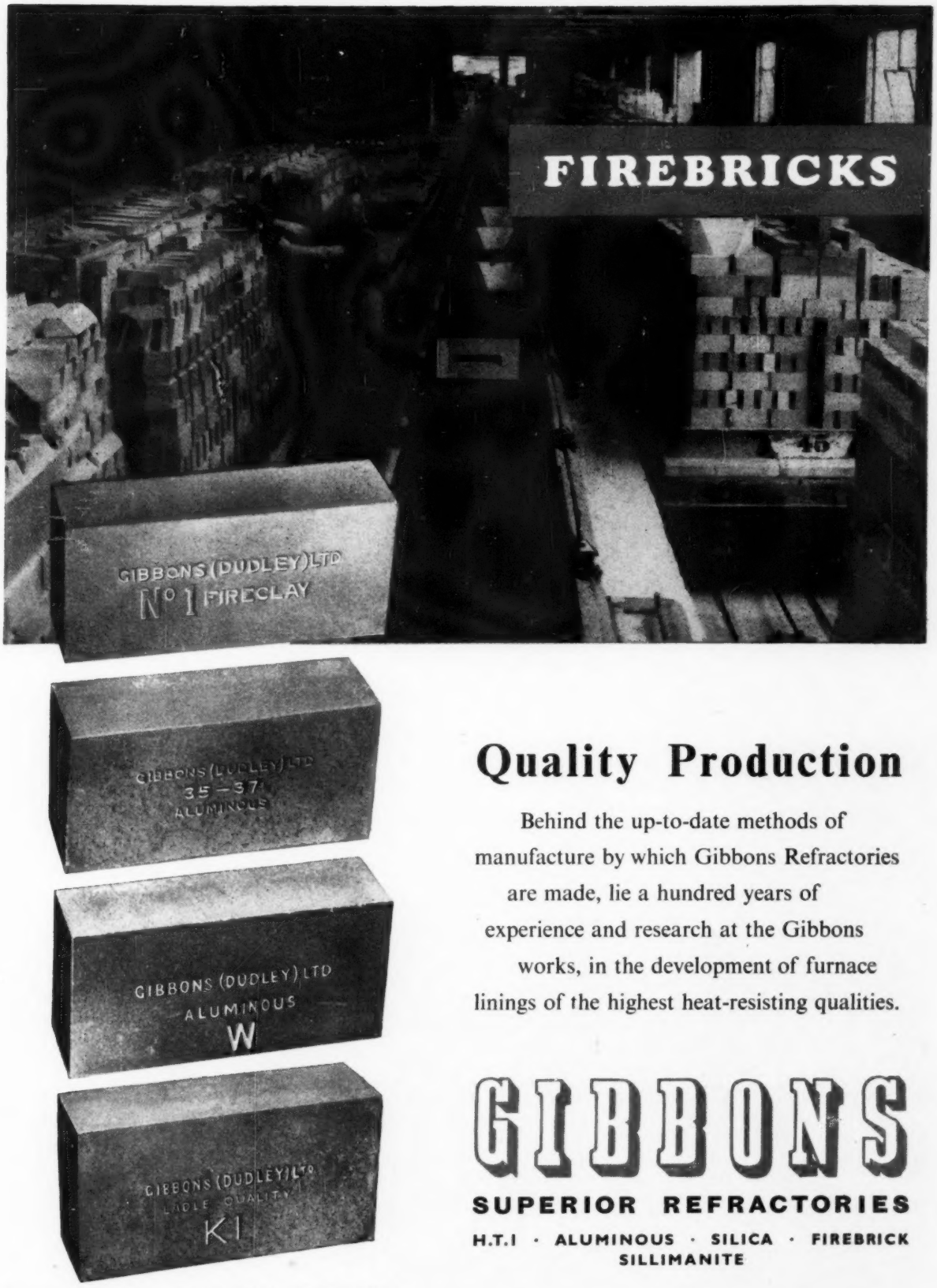

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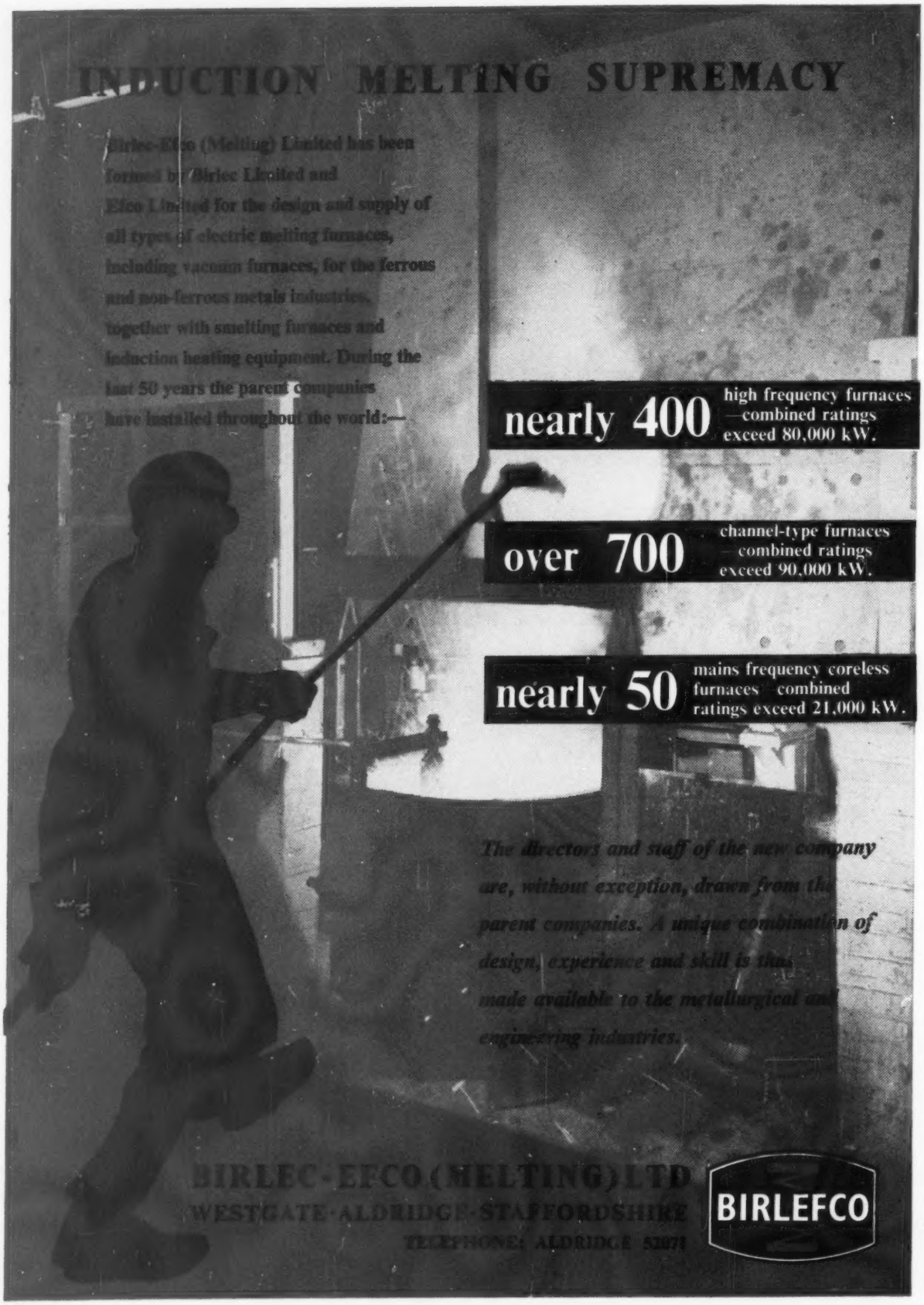
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METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

25 DECEMBER 1959 VOLUME 95 NUMBER 20

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METAL INDUSTRY

VOLUME 95 NUMBER 20 25 DECEMBER 1959

The Tin Quota

NOT everybody apparently is feeling very happy about the recent decision of the International Tin Council to raise the quarterly export quota of tin from 30,000 tons to 36,000 for the first quarter of the New Year, and the decision was undoubtedly a surprise to many producers. This decision has been sharply criticized by A. Strauss and Company in their monthly review for the current month. In this review, the company states that a remarkable feature of the Council's announcement was that at the end of this year the buffer stock would contain at least 10,000 tons of metal. At a subsequent press conference, the Chairman of the Council was asked whether this figure included the 2,417 tons of Government-held metal which is to be handed over to the buffer stock manager for sale on Monday next. The chairman, however, categorically denied this.

In the course of their review, Strauss say that the situation is all the more puzzling as it is known that since the end of June last, when the size of the buffer stock, according to a subsequent report, was 13,990 tons, sales by its manager have been heavy. These were estimated to have much exceeded 6,500 tons, i.e. the 2,500 released by the Government plus 4,000 tons from the stock. How does it come about, it is asked, that during the *six* months during which the liquidation of metal was unquestionably substantial, less than 6,500 tons were sold, when during the previous *three* months the stock was reduced, according to official statements, by as much as 7,000 tons—from 21,020 tons at the end of March to 13,990 tons at the end of June. It is known that, under the wide latitude which prevails at this stage of the scheme's operation, the manager has latterly bought some metal, but all the available evidence suggests that the amount was small. The market can, therefore, offer no explanation for this phenomenon.

It is a little difficult to understand how such a large increase in export quotas can be justified when the buffer stock still holds so much metal. Under the tin agreement, the stock must be fully liquidated by June 1961, and this means that a major part of it will have to be sold during 1960. If sharp price fluctuations are to be avoided it may be impossible to sell the buffer stock, in fact, it may even have to be increased again. Presumably much will depend on the pace of recovery in the world steel industry, but in market circles it is believed that a good deal of tin has been accumulated in the United States during the steel strike, and it is certainly probable that American purchases will remain low for some time to come.

A possible explanation for the decision of the Council to raise the export quota, put forward by Strauss in the review of the situation, is that the apparent mutual interest of producers and consumers to raise quotas as much as, and as quickly as, possible, has resulted in premature action which may counter the benefits that the Tin Scheme has hitherto provided. However, let us hope for the best in 1960.

The Editor extends to all his readers Good Wishes for the Christmas Season

Out of the MELTING POT

Recovery and Use

AS with other plating baths, an important consideration in connection with chemical nickel plating from a bath containing essentially a nickel compound and hypophosphite ions, is what is to be done when such a bath is finally "spent" and can no longer be made up or regenerated. The spent chemical nickel plating bath still contains a considerable amount of nickel and is, therefore, too valuable just to be run to waste. Besides, there may also be present some finely divided nickel which was precipitated as "stray" plating during the time the bath was in use. It is quite easy to precipitate the rest of the nickel present in the bath in the form of a powder by seeding the bath with a small quantity of previously produced nickel precipitate or a small quantity of any catalytic material in finely divided form, such as iron, cobalt, nickel, palladium, etc. The precipitated nickel, like the chemical nickel coatings produced from the bath, and like the "stray" plating mentioned above, contains from 6 to 12 per cent by weight of phosphorus. The conventional method of recovery would involve the filtering off of the nickel precipitate, and its processing by suitable means to recover the nickel. A more direct use for the nickel precipitate has been found, however, namely, in flame spraying. For this purpose, the precipitate is dried, crushed and ground to −200 to −325 mesh, treated with acid to remove iron and other impurities, and finally dried. The material can then be flame sprayed, using one of the known types of powder spray gun. The melting of the material which occurs during spraying results in alloying between the nickel and phosphorus, and the formation of a normal (eutectic-base) nickel-phosphorus alloy, differing in many of its properties from the amorphous nickel-phosphorus composition (having the same chemical analysis) which is deposited from the plating bath. In the spraying process, the presence of the phosphorus improves the wetting properties and, therefore, the adhesion of the coatings. The addition of zinc powder, to form a ternary alloy containing 50 per cent zinc, 44-47 per cent nickel, and 3-6 per cent phosphorus, has been found to give coatings having remarkable resistance to corrosion.

By Magnetism

IF, in an idle moment, you have ever toyed with a magnet, a piece of paper and some small object of magnetic material which you could move over the paper by moving the magnet on the other side of the paper, or if you have ever played a confused game of table football in which the movements of the opposing "players" are controlled by magnets from below the board, you could, if you are also interested in electroplating, have come quite near to inventing a method of moving workpieces through a plating bath. Having thus chanced upon the principle, there remain the details. The first obviously important detail is that the parts to be handled should be magnetic, i.e. normally of iron or steel. While, in principle, it should be possible to handle parts having a wide range of size and shape, in practice it is desirable that the latter should be such that the parts will be able to roll, i.e. the parts should have a substantially spherical or cylindrical shape. Another detail concerns the plating vat. For the principle to be usable, at least the bottom of the vat should be made of some diamagnetic (non-magnetic) material. This should not be a difficult requirement to satisfy. The magnets—one for each part—can be mounted at suitable distances along an endless band conveyor, a length of whose run is arranged to extend underneath the bottom of the vat, though for conveying the parts in and out of the vat it may be desirable for the magnet conveyor to be arranged to run down the outside of one side, then underneath the bottom of the vat, and then up the outside of the opposite side of the vat. The idea of facilitating this arrangement, and also the movement of the parts, by the rounding of the corners between the sides and bottom of the vat is one that should readily come to mind. Finally, ingenuity will have to be exercised in regard to the supply of current to the parts as they are moved through the plating bath by the above magnetic means. The simplest arrangement is to have the current leads extending along the bottom of the vat and to make the parts roll along in contact with them, but other, more ingenious, arrangements may be possible.

Still Worth Considering

PUBLICATION in a recent issue of a Russian technical journal of several articles on the subject of friction welding has produced the inevitable scattered crop of news items which, by their very nature, cannot avoid giving the intended or unintended impression that here is something new, something almost sensational, something one may be missing and, therefore, something one ought to look into. On looking into it one finds, in fact, that the articles are concerned primarily with the power aspects of friction welding and the variables which determine the conversion of power into heat, and the distribution of that heat in the case of butt welds between rods and tubes. As can be readily imagined, the conditions and process variables encountered in friction welding can provide more than one field day for mathematicians, who can set out to calculate the thermal effects of a plane uniform source of heat situated between the abutting ends to be welded, taking into account conduction of heat into the rods or tubes but ignoring the losses of heat from the sides. Where the mathematical approach has had to give up, experiment has provided answers to questions regarding optimum contact pressures, speeds of rotation, and welding times, and information of temperature distribution over the ends, on the flow of the metal, and on the characteristics of the welds. Finally, it is interesting to note the use of friction welding as a means of "putting on" metal for the purpose of building up worn parts. In this connection it is pointed out that the power consumption of the friction welding method is much lower than that of arc welding for the same job. As for its novelty, an editorial paragraph introducing the small collection of articles on friction welding mentions that the process was suggested in 1956 by A. I. Chudikov (Author's Certificate No. 106,270, dated September 5, 1957). Older readers of this page may, perhaps, need reminding of the paragraph entitled "Friction Welding" (this page, METAL INDUSTRY, 25 January 1946, p. 62) in which I discussed the possibilities of the technique following upon its being claimed in British Patent 572,789 (application date October 17, 1941).

Skimmer

ANALYSIS OF DATA BY SIMPLE MATHEMATICAL TESTS

Quick Statistical Methods in Metallurgy

By W. E. DUCKWORTH, M.A., A.I.M., A.I.S.

PRACTISING metallurgists are continually examining figures, be they tensile strength, hardness, grain size, analytical composition, or porosity. Very often the meaning of the data is not readily apparent. For example, tensile tests on an aluminium alloy subjected to two different heat-treatments may give the following sets of results.

Heat Treatment A U.T.S. tons/in²		Heat Treatment B U.T.S. tons/in²	
28·9		28·9	
29·3		29·4	+
28·8		29·5	+
28·9		28·7	−
28·7		29·1	+
29·4		29·8	+
29·7		29·4	−
28·4		29·3	+
29·0		29·7	+
29·1		29·6	+
29·1		30·2	+
29·2		29·2	
28·6		29·9	+
28·8		29·8	+
29·0	Average	29·5	

There is a difference of 0·5 tons/in² in the average strength. Does this mean that there is a real difference in the effect of the heat-treatment or not? By real difference is meant one which would be observed again if the experiment were repeated.

This is the kind of question which it is often of vital importance for the metallurgist to answer. The materials with which he works are very variable, and it is not sufficient for him to claim that a certain effect has been observed in one trial. He is expected to produce results upon which some estimate of the future can be based.

In this case, is it possible for the metallurgist to assert that the difference of 0·5 tons/in² between the two heat-treatments is sufficiently greater than the variation of results within each heat-treatment for it to be stated with some degree of conviction that one heat-treatment is better than the other?

It may seem to some readers that a discussion over a difference in strength as small as 0·5 tons/in² is purely academic, but in research investigations or plant investigations into product improvements, differences of this order relative to the error of measuring them frequently occur, and are important to detect and be precise about.

In short, the metallurgist has very variable materials to handle. The numerical results he obtains are always liable to show a considerable scatter. He must, therefore, be equipped to extract useful results from his data despite their variability.

The way to do this is by using the methods of mathematical statistics, and their value in metallurgical work has been emphasized in the literature.[1,2,3,4] They have not gained general acceptance among metallurgists, however, because of difficulties in their application. Metallurgists are not always good mathematicians, and the tests are often tedious to calculate without skill in their manipulation and possibly the aid of some computing machinery. These are not usually to hand on the floor of a foundry or the platform of a rolling mill.

Statistical tests have now been developed, however, which are very quick to compute; they can be carried out during the scanning of data and require, in general, no greater mathematical aptitude than the ability to count and to extract an approximate square root.

To illustrate the speed with which these tests can be carried out, consider the above example of the heat-treated aluminium alloy. Where heat-treatment B has given a greater strength than heat-treatment A, a plus sign is put at the side of the figure, where A has given the higher strength a minus sign is placed, and where the two results are identical no entry is made.

It will be seen that there are ten plus signs and two minus signs. The simple rule for testing whether the predominance of plus signs is significant in the statistical sense, is to compare the difference between the number of plus signs and the minus signs with twice the square root of their sum. If the difference is greater than, or equal to, twice the square root of the sum, then the result can be said to be significant. Thus:—

$10-2$ is compared with $2\sqrt{10+2}$

$10-2=8$

$2\sqrt{10+2}=2\sqrt{12}=2\times3{\cdot}5$ approx.

$=7$ approx.

Since 8 is greater than 7, it can be said that the number of plus signs is significantly greater than the number of minus signs or, in other words, that heat-treatment B gives a significantly higher tensile strength than treatment A.

The term "significant" is used in the statistical sense, i.e. an event is considered significant if its occurrence by chance is comparatively rare. In normal statistical usage, an event which would only occur by chance once in twenty times is judged significant. This is a smaller probability than that of getting four heads with successive throws of a coin. The safeguard this gives the reader in using statistical tests to separate the real happenings from the chance ones can, therefore, be assessed by him. Where even this risk of obtaining a wrong judgment is considered too great to be run, then other rules can be applied, as given at the end of this article.

This test of comparing a difference with twice the square root of the sum is very quick, and can be applied in a number of cases. For example, suppose a series of percentage porosity readings on powder metal compacts is obtained as follows:—

1·23, 1·15, 1·06, 0·87, 1·36, 0·78, 1·35, 1·11, 1·07, 1·13, 0·95, 1·29, 1·11, 1·03, 1·26, 0·98, 1·06, 0·92, 1·08, 1·09, 1·20.

The usual figure is 1·03 per cent. Has the porosity increased or not? There is no need even to work out the average. The number of results higher than 1·03 per cent and the number of results lower than 1·03 per cent are counted, any results equal to 1·03 per cent being ignored.

There are 15 numbers higher than 1·03 per cent and 5 lower. The difference is 10 and the sum 20.

$2\sqrt{20}=2\times4{\cdot}5=9.$

The difference, 10, is greater than 9, therefore a significant change in the level of porosity has occurred.

Here is another example. Is the hardness of the alloy from which the following readings are taken significantly different from 24?

30, 24, 17, 22, 16, 18, 20, 16, 10, 28, 30, 17, 15, 28, 13, 12.

There are 4 numbers more than 24; 11 less than 24.

Difference is $11-4=7$

Sum is $11+4=15$

$2\sqrt{15}=2\times4$ approx. $=8$ approx.

The difference is, therefore, less than the square root of the sum, and hence the average is not significantly different from 24.

The average is different, of course, and what this statement really means is that the average of the population of which these numbers are a sample may not be different from 24. In life a sample is always examined—a year's production figures are just a sample of the possible population of years' production figures—and the object is to determine from the sample the properties of the population. What, in other words, the "true" average would be if it were known. Here there is no sound evidence that the "true" average is different from 24, and to act as if it were may be unwise.

Action may be necessary, of course,

and the difference so disturbing that it might be well to act as if it were significantly different. The statistical test does not tell what action to take, obviously, but it tells what justification there is, *on the data alone* for the action taken. In this case, on the data alone there is no justification for acting as if the "true" average of the group was different from 24, but there may be other considerations to take into account. The situation may be one where there is no harm done if the average is incorrectly assumed to be different, whereas harm would be done if it were incorrectly assumed that the average were not different. Clearly, in that situation it would be better to act as if the average were different, but if there were compelling reasons for acting one way in preference to another, then it would be better to collect more data.

There is a simple rule about the extra amount of data to collect. In the third example above, the "difference" count was 7, and this was not significant because it was less than $2\sqrt{15}$ where 15 was the "sum" count. If, however, the "true" average of the group of numbers examined were less than 24—and the only reason this has not been clear so far is because there was inadequate data—then the amount of data needed to make certain is $\left(\frac{\text{twice sum}}{\text{difference}}\right)^2$. In this example it would be $\left(\frac{2\times 15}{7}\right)^2 = 18$.

Three more observations would, therefore, be required *provided* that the "true" average of the group was below 24.

Clearly, if three more observations were taken, and at least one were greater than 24, then a repeat test would still not show significant difference for :

new sum = 18
new difference = 13 − 5 = 8
twice square root sum = $2\sqrt{18} = 8\frac{1}{2}$

which is still greater than the difference.

A repeat test is thus necessary after the further data have been collected, and this may indicate that still further information is needed. The amount of this can be calculated.

If only a small amount of extra data is needed then this may be readily collected, and the metallurgist may well be prepared to take what he feels to be the appropriate decision while it is being collected. If a large amount of extra data is needed, which would certainly be the case if the initial test gave a result which was far from being significant, then this may serve to emphasize to the metallurgist the inadequate basis for any decision which would imply significance in the data.

Test for a Trend

It is often important to know when figures are showing a trend up or down. Scrap may appear to be increasing, output may appear to be falling. Before taking action, the metallurgist may want to satisfy himself that the trend is real and is not due to chance.

The figures can be examined in the following way. Divide them into three equal, or approximately equal, portions and compare the third portion with the first one.

Example A—

The following figures appear to show a trend.

9·5, 9·1, 9·0, 9·5, 10·0, 10·0, 10·2, 10·7, 10·4, 11·5, 11·2, 11·6, 10·2, 11·8, 12·0.

There are fifteen numbers. Divided into three equal groups of five numbers they become

(i)	9·5	9·1	9·0	9·5	10·0
(ii)	10·0	10·2	10·7	10·4	11·5
(iii)	11·2	11·6	10·2	11·8	12·0

Comparing the first group with the third, it is seen that each number in the third group is higher than its equivalent one in the first group: 11·2 is higher than 9·5, 11·6 is higher than 9·1, and so on. There are five comparisons, and in each one the third group is higher. To decide whether this means that the third group is significantly greater than the first group, use the same formula $2\sqrt{N}$ described earlier. In this case N is the total number of comparisons between the two groups and $2\sqrt{N}$ is the amount by which the comparisons favourable to the third group must exceed those favourable to the first group. In the above example $N=5$, therefore $2\sqrt{N}=4{\cdot}5$.

The number of comparisons favourable to the third group was 5, the number favourable to the first group was zero. The difference was, therefore, 5, which is greater than 4·5, and hence the observed trend is significant.

Example B—

Is there a trend in the following figures?

20, 21, 37, 25, 39, 46, 29, 10, 49, 45, 15, 7, 57, 44, 23, 28, 59, 50, 40, 31, 41, 24, 47, 51, 42, 47, 55, 47

There are 28 numbers, so the first and third groups contain 9 each, in which the comparisons are as follows:

Comparison		Favourable to 1st group	Favourable to 3rd group
20	31		1
21	41		1
37	24	1	
25	47		1
39	51		1
46	42	1	
29	47		1
10	55		1
49	47	1	
		3	6

The excess number is 3, $N=9$

$2\sqrt{N}=2\sqrt{9}=6$

Since 3 is less than 6, there is no evidence of the existence of a trend. Further information could, of course, be collected. The amount of further information necessary is given by the same formula $\left(\frac{2\times\text{sum}}{\text{difference}}\right)^2$ as before.

ASSOCIATION

It is very often necessary to know whether two groups of numbers are connected : whether, for example, hardness decreases as tempering temperature rises, or whether the cost of consumable supplies is related to output. A rapid test for an association of this nature between numbers is illustrated below.

	A	B
	4·9	8·6
	5·3	8·7
	4·7	8·5
	5·1	8·6
	5·4	8·6
	4·6	8·4
	5·0	8·5
	5·5	8·7
	4·8	8·4
	4·5	8·5
	5·2	8·6
Average	5·0	8·55

The number of pairs in which *both* figures are higher and both figures are lower than the respective average is then counted. In this example there are nine such pairs, i.e. all pairs except

4·9 8·6
and
5·0 8·5.

The number of pairs in which one figure is higher and the other figure lower than the respective average is then counted. In this case it is one

4·9 8·6

The pair 5·0 8·5 is not included because 5·0 is the average of one group. The difference between the two sets of pairs is then calculated and this is once more assessed by the $2\sqrt{N}$ criterion.

In this example the difference is

9 − 1 = 8

The total number of pairs, N, is 10. Therefore $2\sqrt{N}=2\times 3{\cdot}3=6{\cdot}6$.

Since 8 is greater than 6·6, the association is significant.

Example C—

Is there an association between the following pairs of numbers?

	14·7	2·80
	13·4	2·74
	14·9	2·73
	14·7	2·81
	13·2	2·78
	13·0	2·70
	14·3	2·69
	15·0	2·83
	13·4	2·72
	13·7	2·80
	13·3	2·73
	14·7	2·77
Average	14·0	2·76

The number of pairs in which *both* figures are higher or lower than the

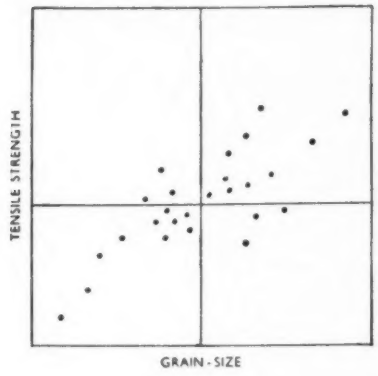

Fig. 1

respective average is 8. The number of pairs in which one figure is higher and the other lower is 4.

The difference is thus $8-4=4$.

The total number of pairs is 12.

$$2\sqrt{12}=7.$$

Since 4 is less than 7 there is no significant association. Once again the amount of further information necessary to establish a significant association, if such exists, can be predicted from the formula $\left(\frac{\text{twice sum}}{\text{difference}}\right)^2$

SPOTTING A STRANGER

Sometimes when a group of numbers is examined one or two figures do not seem to belong. An example is given below.

1·04, 6·75, 7·97, 9·72, 3·51, 2·62, 26·54, 3·66, 8·09.

In this group the number 26·54 seems to be a stranger. How can we be sure it is all right to reject it from the group or to make it the subject of a special enquiry? The test is to subtract the smallest observation in the group from the largest, first including the suspected stranger and then excluding the suspected stranger. In this case we get

$$26{\cdot}54-1{\cdot}04=25{\cdot}50$$

and

$$9{\cdot}72-1{\cdot}04=8{\cdot}68$$

The ratio of these ranges is about 3. If the range with the suspected stranger is at least twice the range without the suspected stranger, then the suspected stranger does not belong to the group. The statistical test does not of itself, however, provide sufficient justification for rejecting the suspect figure. Some physical reason, such as abnormal conditions under which the particular figure was obtained, must be discovered before analysis of the data can safely proceed.

Example D—

10·3, 11·5, 3·1, 13·7, 14·3, 13·8, 11·9

Is 3·1 a stranger?

The range including 3·1 is

$$14{\cdot}3-3{\cdot}1=11{\cdot}2$$

The range excluding 3·1 is

$$14{\cdot}3-10{\cdot}3=4{\cdot}0$$

Thus $\left(\frac{11{\cdot}2}{4{\cdot}0}\right)=2{\cdot}8.$

This is more than 2, hence 3·1 is a stranger.

Another Test for Association

When an association or correlation is suspected between two groups of numbers, say between grain size and tensile strength, a graph is often plotted, as in Fig. 1. With such a graph, another simple statistical test can be carried out without the need to use the original data. This is the kind of test which can be used by a senior metallurgist looking at the results which his juniors have plotted.

Let us suppose that there are 26 observations. A horizontal line is drawn which divides them in half, so that there are 13 above and 13 below it. A vertical line is also drawn to divide them in half, so that there are 13 to the left of it and 13 to the right of it. The graph is then as illustrated in Fig. 2. A ruler is then placed horizontally and moved downwards from the top, counting the number of observations in the top-right quadrant B, before an observation occurs in the top-left quadrant A. In Fig. 2 there are five. The ruler is then placed vertically and moved from right to left and the number of observations in the top-right quadrant B is counted before coming to an observation in the bottom-right quadrant D; in this example there are two. A similar procedure is then applied to the two lower quadrants and the two left-hand quadrants, and it is found that the total comes to 14. It has been worked out that, with a score equal to or greater than 11, the correlation is significant.

Of course, if there are only a few results, as in the above example then the $2\sqrt{N}$ criterion can be used in this situation. The number of points in one opposed pair of quadrants is compared with the number of results in the other opposed pair.

Thus, in Fig. 2 the number of results in the quadrants B and C enclosed by the full lines is compared with the number of results in the quadrants A and D as below:

No. in B and C = 20
No. in A and D = 6
Difference = 14
Sum = 26

Twice square root sum $= 2\sqrt{26}$
$= 10$ approx.

The correlation is again shown to be significant. Both tests can, therefore, be used in interpreting graphical results, but where there are many points and the density in the centre of the graph is very high the method of moving the ruler and counting:—the so-called 'quadrant sum' test is much quicker and easier to apply than the $2\sqrt{N}$ test.

Comparison of Groups with Unequal Numbers

The $2\sqrt{N}$ test only applies when there is either a single group of numbers as in testing for a significant

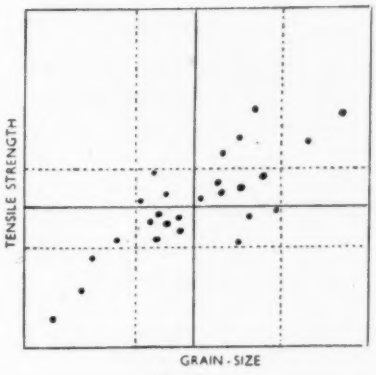

Fig. 2

change in average or two equal groups as in association or trend or testing for a significant difference in average between two equal groups. It cannot be applied when testing for a significant difference in average between two unequal groups.

Consider the following situation:

Tensile strength in tons/in^2	
Alloy A	**Alloy B**
9·5	9·4
9·1	9·6
9·0	9·2
9·5	8·0
12·2	8·9
10·0	8·5
10·7	9·7
10·4	11·1
11·5	9·4
11·2	11·4
11·6	9·8
10·2	9·3
11·8	
12·0	

The $2\sqrt{N}$ criterion cannot be applied here because two more results have been obtained for alloy A than for alloy B. The solution is not to chop off the last two results for A because this is wasting information and if the $2\sqrt{N}$ criterion is applied it gives a non-significant result which is, in fact, untrue.

The method to apply is to find the highest observation and the lowest observation in each group. For A the highest observation is 12·2 and the lowest is 9·0. For B the highest observation is 11·4 and the lowest is 8·0. We then find the number of observations in the A group which are higher than the highest in the B group. (It is obvious that the highest and lowest figures of the A group are higher than those of the B group.) In the A group there are five observations (12·0, 11·8, 11·6, 11·5, and 12·2) higher than the highest observations in the B group. There are also three observations in the B group (8·0, 8·9, 8·5) lower than the lowest observation in the A group. We add the 5 and 3 and get a score of 8.

Professor Tukey[5] of Princeton University has worked out that if the score is equal to or greater than 7 it can be said that the difference is significant,

TABLE I—RISK CRITERIA

Significance Level	$\sqrt{N}$ Test	Tukey Test	Number of Results Needed
1 in 10	$1{\cdot}6\sqrt{N}$	4	$\left(\frac{1{\cdot}6N}{D}\right)^2$
1 in 20	$2\sqrt{N}$	7	$\left(\frac{2N}{D}\right)^2$
1 in 100	$2{\cdot}6\sqrt{N}$	10	$\left(\frac{2{\cdot}6N}{D}\right)^2$
1 in 1000	$3{\cdot}3\sqrt{N}$	14	$\left(\frac{3{\cdot}3N}{D}\right)^2$

The score in the example chosen is 8, so that it is significant.

All the tests given have been for a significance level of 1 in 20 or 5 per cent. That is, when using these tests a chance effect will only be judged to be significant and real with a 1 in 20 risk. If it is required to run a higher or a lower risk then the criteria are given in Table I.

Conclusion

These tests are all ones which can be memorized easily, or noted in a diary, and used when examining data to extract their significance more precisely than using intuition. It must be emphasized, however, that they are only a kind of statistical first aid and that proper statistical analysis using more conventional methods should always follow if the full meaning of the data is to be extracted.

They are certainly better than nothing, however, and if this article has helped to stimulate interest in statistical methods among metallurgists and has encouraged them to use, first, these simple tests and then, later, more advanced tests it will have done its job.

A list of references and a bibliography is attached so that further study of the subject can be made.

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2 M. Whyte; *ibid*, 1954, **82**, 335.
3 A. R. Martin; *ibid*, 1956-57, **85**, 209.
4 L. A. Deaville; *Foundry Trade J.*, January 9, 1958, 104.
5 J. W. Tukey; A Quick, Compact, Two-Sample Test to Duckworth's Specifications. *Technometrics* No. 1, Vol. 1, 1959.

Further information on the quick tests is given in the paper 'Rapid Statistical Techniques for Operational Research Workers', by W. E. Duckworth and J. K. Wyatt, published in the Operational Research Quarterly Volume 9, No. 3, p.218, 1958.

Two good general books to read on statistical methods are:

'Facts from Figures', by M. J. Moroney, Penguin Books, 1951; and

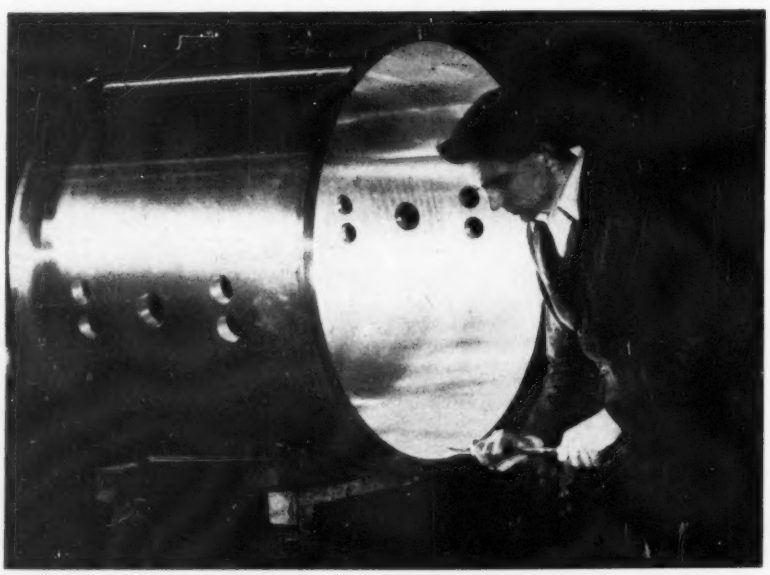
'Statistical Methods in Research and Production', by O. L. Davies, 2nd edition, Oliver and Boyd, 1949.

Aluminium-Tin Bearing Alloys

LOW-TIN-CONTENT aluminium alloy has been used for bearings in place of conventional materials, such as Babbitt metals (both lead- and tin-based) and bronzes, for a number of years in Europe and the United States and it is being increasingly used in this country. Davy and United Engineering Company Ltd. are now offering aluminium-6½ per cent tin alloy bushes in the Morgoil specialized bearing system for rolling mills as an alternative to white-metal steel-backed bearings since aluminium-tin alloy has been found to be technically and economically acceptable for specialized applications such as this.

Morgoil bearings with aluminium-tin bushes have been fitted on the back-up rolls of 7 ft. and 12 ft. steel rolling mills in this country. One mill has recently completed three years' service, during which time more than 500,000 tons of steel were rolled, and when the bearings were examined they were found to be in good condition. Bushes for bearings of this type are cast from Noral 730 aluminium alloy supplied by Northern Aluminium Company Ltd., this alloy being particularly suitable as a bearing material where high loadings and speeds are encountered and where adequate lubrication is available. A bush 36 in. in diameter and weighing 800 lb., fitted on a 7 ft. mill is shown in the accompanying illustration. Other ferrous and non-ferrous metal-rolling mills in this country and in Europe have been fitted with aluminium-tin bushes either as part of a specialized bearing system, such as Morgoil, or as plain bearings.

Noral 730 is composed of 6½ per cent tin, 2½ per cent silicon and 1 per cent copper, with the remainder aluminium; it has a 0·1 per cent proof stress of 4 tons/in², an ultimate tensile stress of 10 tons/in², and has been specifically developed for solid bearings, i.e., bearings that do not need a backing material to give strength. The qualities of tin as a bearing material are combined with the strength of aluminium to give excellent wearing characteristics. With a thermal conductivity three times greater than that of steel and five times greater than Babbitt metal, Noral 730 is plastic enough to conform to any normal misalignment, it embeds particles easily and is, therefore, highly suitable for heavy duty machinery such as rolling mills. These properties enable it to be used economically for bushes in diesel engines, hydraulic presses and pumps, electric motors, cranes, dredgers, lathes and combine harvesters; applications that have been successful in the United States, but for the majority of which this alloy is as yet untried in this country.



Finishing Supplement

Immersion Plating on Zircaloy-2

By L. R. KOHAN

A number of immersion plating baths, for plating copper, iron, tin and nickel on Zircaloy-2, involving hydrofluoric acid, were formulated by Westinghouse Atomic Power Division, and evaluation work was continued at the Armour Research Foundation. The results of these investigations are described here, but deposition of other metals is also possible.

EFFORTS have been made to deposit a uniform coating of a desired metal (e.g. copper, iron, tin, and nickel) on Zircaloy-2 (1·5 per cent tin, 0·12 per cent iron, 0·10 per cent chromium, 0·05 per cent nickel, balance zirconium). Electroplating could not be utilized since the thickness of such a coating would be expected to vary considerably over 4 to 6 ft. flat sections. Immersion plating, if possible, would provide a method of obtaining a uniform coating, easily controllable to the desired specification of ±0·03 mil.

Generally, immersion coatings are of the order of one or two atoms in thickness. In the replacement plating of Zircaloy-2 the deposit is quite porous, thus allowing an appreciable build-up in thickness. Surprisingly, adhesion is quite good. This may be due more to mechanical bonding than to chemical bonding, since the Zircaloy becomes somewhat etched during the plating process.

Theoretically it should be possible to immersion deposit any metal more noble than zirconium.

Since the condition of the surface to be plated affects the uniformity of the coating to a great extent, a method of pretreatment was formulated from which reproducible surface conditions could be obtained. The method employed was as follows:

(1) Vapour blasting with 350 grit material.

(2) Cathodic electrolytic cleaning in a suitable proprietary alkaline cleaner. (a) Concentration, 45 gm/L; (b) Temperature, 88°C.; (c) Current density, 100 amp/ft^2; (d) Time, 1 min.

(3) Water rinse.

(4) Pickling. (a) Composition: HF (48 per cent) 1 part, HNO_3 (conc.) 9 parts, H_2O 10 parts; (b) Temperature, room (approximately 78°F.); (c) Time, 30 sec.

(5) Water rinse.

(6) Immersion plate.

Copper Immersion Plating

Preliminary research had formulated a bath for the displacement plating of Zircaloy-2 by copper. The composition of this bath was:

$Cu(NO_3)_2 \cdot 3H_2O$	50 gm.
HF (48 per cent)	7 mL
H_2O	1 L

Operated at room temperature, with air agitation, the solution produced a coating which was acceptable in appearance. It was found that thickness control was somewhat difficult. Therefore, the hydrofluoric acid concentration was reduced to 2·5 mL/L of water. Copper thickness became much easier to control with this change.

Once an acceptable immersion copper bath was found, it became necessary to determine what effects were introduced by changing bath variables, such as agitation, temperature, hydrofluoric acid concentration, *p*H, and cupric ion concentration. For this study, a tank was constructed which would provide uniform agitation. Fig. 1 shows the geometry of the tank used for the investigations. The first variable to be investigated was agitation. After pretreatment as previously discussed, two runs were made with the flow of nitrogen gas varied between 0 and 16 L/min. Five specimens of Zircaloy-2, measuring 1 in. × 2·375 in. × 0·40 in., were plated simultaneously in each run.

Copper thickness varied considerably in the 15 min. of plating, depending upon the amount of agitation. When no agitation was present, a thickness of only 0·034 mil was obtained; at a flow of 16 L/min., 0·176 mil of copper was deposited.

Uniformity between specimens was quite good, with optimum uniformity observed between 7 and 10 L/min. flow rate.

In order to determine the exact relationship of solution temperature to plating rate, a series of tests was run in which the copper bath temperature was raised from 80°-130°F. in 10°F. intervals. Agitation and hydrofluoric acid concentration were kept constant at 10 L/min. of gaseous nitrogen and 2·5 mL/L hydrofluoric acid, respectively. Pretreatment was, of course, identical with that described. Three separate runs were made, with a fresh bath used for each run.

Results showed that the relationship between plating thickness and bath temperature is linear. A total difference of 0·05 mil was caused by raising the bath temperature from 80°-130°F., with a plating time of 15 min. These experiments indicate that small variations in the bath temperature would cause no drastic changes in the rate of copper deposition.

Since such small changes in copper thickness were observed with changes in temperature, 100°F. was chosen for all further studies, as this temperature would be convenient in production.

The hydrofluoric acid level has a very great effect on the rate of copper deposition. For this study, temperature and gaseous nitrogen agitation were kept constant at 100°F. and 10 L/min. of wet nitrogen respectively. The hydrofluoric acid concentration was varied from 1 to 5 mL/L. Using a fresh bath for each run, three test runs were made.

A very rapid increase in the copper

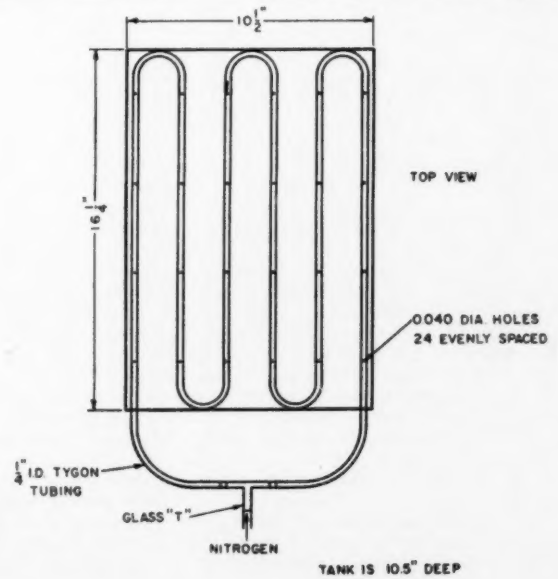


Fig. 1—Gas-agitated plating tank showing the configuration of tubing containing outlet orifices

plating thickness occurs with small increases in the concentration of hydrofluoric acid, lessening as the hydrofluoric acid level approaches 4 mL/L.

In each of the three runs the copper thickness was well within the ±0·03 mil tolerance expected for each level of hydrofluoric acid.

When the hydrofluoric acid concentration was used above 4 mL/L it was noted that the copper deposit did not present quite as uniform an appearance as produced at the lower concentrations. In some cases, bare areas of Zircaloy about the size of pinheads could be seen on the plated surface. Therefore, it was decided that the hydrofluoric acid at 2·5 mL/L in all likelihood, would produce the optimum coating.

Under the same conditions for plating as used previously (i.e., 100°F., 15 min., 2·5 mL/L hydrofluoric acid, and 10 L/min. of nitrogen for agitation), the cupric nitrate concentration was varied between 5 and 70 gm/L. When the $Cu(NO_3)_2 \cdot 3H_2O$ level was 5-10 gm/L, the thickness of the deposit was lower than the average for the remaining runs. The plating thickness obtained is quite constant (±0·02 mil) between 30 and 70 gm. of cupric nitrate per litre of water. Below this range the rate of plating drops off appreciably. It was also found that adhesion of the copper deposit was poor at the lower values.

Since very little change was noted in the immersion plating characteristics of the bath at the various cupric nitrate concentrations above 30 gm/L, it was felt that the use of 50 gm/L as the cupric nitrate concentration would be preferred. This would allow a very wide latitude in controlling the bath and would be the minimum level needed to provide an adequate safety factor.

For the final study of the immersion copper plating process, large sheets of Zircaloy-2 were plated in a bath with the following concentrations and conditions:

$Cu(NO_3)_2 \cdot H_2O$	50 gm.
HF (48 per cent)	2·5 mL
H_2O	1 L
Temperature	100°F.
Nitrogen Agitation Flow	10 L/min.
Time	60 min.

In each run 100 to 200 in² of material were plated until a total of 1,271 in² was processed. The first run produced a thickness of 0·359 mil, which was a considerably higher value than that produced by any succeeding run. In the final run, the thickness of copper deposited was only 0·055 mil. When plating thickness is plotted as a function of area of Zircaloy-2 plated, a sharp decrease in thickness is evident, with each additional run, until a slight levelling off of the curve occurs as the thickness nears 0·10 mil.

Determinations were also made on the actual amount of copper deposited from the bath. The solution originally contained 197·5 gm. copper, and 30 gm. were deposited at the end of the test, thus only 17·7 per cent of the available copper was used.

While it appears that the effectiveness of the bath has practically ceased when only 17·7 per cent of the copper has been removed, plating rate can be increased through the addition of hydrofluoric acid.

At the completion of the study of the effect of depletion of copper, a white precipitate was found in the bottom of the plating tank. This precipitate was analysed spectrographically and found to be ZrO_2 with minute amounts of aluminium, copper, magnesium, nickel, antimony, silicon and zinc. The analysis showed the precipitate to contain 36·9 per cent Zr as ZrO_2.

In the studies of the different variables, *p*H measurements were made as a matter of course during each run. Changes in *p*H were found to be insignificant in all cases except the depletion studies. There, the *p*H dropped from 1·61 after the first run to 1·08 after the eighth. Generally, though, such a change in *p*H should not have much effect, if any, on the general plating process.

From the data and experimental work it is evident that immersion copper plating on Zircaloy-2 can be carried out without fear of major difficulties in controlling the process. While it is true that the life of the bath may be somewhat limited due to the build-up of dissolution products of the Zircaloy, this should not prove to be a great deterrent when considering the uniformity of the immersion coating process and the ease of thickness control. Life of the bath can be extended by the addition of hydrofluoric acid as work is processed.

The actual chemical process of plating probably involves two main reactions, the first being the actual replacement of the zirconium by copper:

$$Zr + 2Cu(NO_3)_2 + 6HF \rightarrow 2Cu + H_2ZrF_6 + 4HNO_3$$

and the second being the further reaction of the H_2ZrF_6 complex with water:

$$H_2ZrF_6 + 2H_2O \rightarrow ZrO_2 + 6HF$$

Thus, it can be seen that there is no loss of hydrofluoric acid during the process, but rather a "tying up" of the fluoride ion in the formation of the ZrF_6 complex ion, which is readily soluble in the bath. Of course, as additional Zircaloy-2 is plated, more zirconium is dissolved in the bath and the concentration of zirconium ion increases. It was found that the zirconium concentration was 2·1 gm/L after the depletion studies.

In a replacement plating process the efficiency generally decreases as the concentration of dissolution products increases. With the immersion copper bath, some of the dissolved zirconium is removed as a ZrO_2 precipitate; but very little of the oxide is formed when compared to the amount of zirconium being replaced. The increase in the zirconium concentration is probably the primary cause for the reduction in the copper deposition rate.

Iron Immersion Plating

Attempts were made to immersion plate iron with the following bath:

$FeCl_2 \cdot 4H_2O$	50 gm.
$CH_3CHOHCOOH$ (lactic acid)	10 mL
HF (48 per cent)	7 mL
H_2O	1 L

A covered high temperature polyethylene tank heated by a 2 kW tantalum-sheathed heater was used. Temperature was kept constant at boiling. This also provided vigorous agitation. With this bath, the dissolution of Zircaloy-2 proceeded at a much faster rate than would normally occur for the replacement process. Very heavy pitting of the samples was encountered and the coating had a coarse appearance.

In an attempt to improve the immersion iron plating process another bath composition was prepared:

$FeCl_2 \cdot 4H_2O$	50 gm.
$CH_3COONa \cdot 3H_2O$ (sodium acetate)	10 gm.
HF (48 per cent)	2·5 mL
H_2O	1 L

Once again, temperature and agitation were maintained by boiling. By means of this solution, the severe etching was eliminated and an adequate iron plating rate was achieved.

Since the plating operation is accomplished at boiling, it became obvious that this might present a problem in production. Therefore, attempts were made at lowering the plating temperature. Coupons were immersed for plating at 140°F. and 170°F. Very thin spotty coatings resulted. These were inadequate in thickness and uniformity for diffusion bonding operations.

Varying the hydrofluoric acid concentration from 1 to 5 mL/L produced dramatic differences in the rate of iron deposition. The plating rate rises rapidly with each addition of hydrofluoric acid until a concentration of 4 mL/L is reached. With the next addition a slight drop in plating thickness is noted.

In order to minimize the effects of evaporation during the determination of the effect of ferrous chloride concentration, a fresh bath was prepared for each level of ferrous chloride. This also eliminated possible losses of hydrogen ion through the formation and evaporation of acetic acid. Results were similar to those found when varying copper nitrate concentration.

As in the study of immersion copper plating, an iron bath was prepared and large areas of Zircaloy-2 were plated until the plating rate had been reduced to an insignificant amount. Plating time for each run was 30 min., and a total of eight runs was made.

Approximately 0·221 mil of iron was

deposited during the first half hour. The thickness dropped to only 0·038 mil after 920 in² of Zircaloy-2 was plated. These results are quite similar to those encountered during the copper depletion studies, except that the thickness does not level off quite as fast.

Once again, the actual amount of metal deposited from the bath was determined. Although 17·7 per cent of the available copper was deposited before the thickness became insignificant, only 6 per cent of the available iron was reduced from the bath. It is obvious that the effectiveness of the bath has virtually ceased when only a small portion of the available iron is used. As in the copper process, an addition of hydrofluoric acid to the bath will result in an increase in the plating rate.

The problem of control of the immersion iron plating process is somewhat greater than in the case of the 100° F. copper bath, but is not insurmountable. For laboratory work, a lid was used with the high-temperature polyethylene tank. This cover was concave, thus allowing cold water to be circulated in it and, in effect, forming a condenser to prevent evaporation. Since the cover did not form a tight seal, some evaporation did occur.

Another difficulty encountered was in drying after plating. If the plated sample was allowed to remain wet for a few minutes after removal from the plating tank, it would begin to rust. To stop the formation of rust, samples were quickly water rinsed and placed in a tank containing absolute alcohol. They were then removed and dried by means of a hot-air dryer. After drying, they were carefully wrapped and placed in a desiccator. Once this drying method was introduced, rusting ceased to be a problem.

The plating reaction is probably somewhat similar to that in the immersion copper plating process. It was noted that the free acid remained quite constant after dropping slightly at the beginning. It is thought that this decrease is most likely caused by the evaporation of acetic acid which forms in the bath. If this is true, there would be no loss in acid during the plating and the reaction might be:

$$Zr + 2FeCl_2 + 6HF \rightarrow 2Fe + H_2ZrF_6 + 4HCl$$

Very often, a dark brown precipitate was found in the plating solution. Analysis showed it to be 66·44 per cent iron as $Fe(OH)_3$ and Fe_2O_3. In some instances, little or no precipitate was found to be present. No explanation is offered for this.

Tin Immersion Plating

Another of the materials studied for the diffusion bonding process was tin. Studies in immersion tin plating led to the formulation of the following solution:

$SnCl_2 \cdot 2H_2O$	50 gm.
$CH_3COONa \cdot 3H_2O$ (sodium acetate)	10 gm.
HF (48 per cent)	2·5 mL
H_2O	1 L

Air agitation and a temperature of 205° F. were used.

The deposit produced was crystalline in appearance and quite adherent. It could only be removed by scraping with a sharp object. Plating thicknesses of 0·2 mil were produced in 30 min.

Nickel Immersion Plating

For nickel immersion plating the plating conditions used are as follows:

(1) Composition—

$NiCl_2 \cdot 6H_2O$	50 gm.
$CH_3COONa \cdot 3H_2O$ (sodium acetate)	10 gm.
HF (48 per cent)	4·0 mL
H_2O	1 L

(2) Temperature, boiling (to provide both agitation and constant temperature).

(3) Time, 35 min.

(4) *p*H, 4 to 5.

With the above plating bath, the deposition of nickel is quite rapid during the first few minutes but, after 20 min., the rate is reduced considerably. After approximately 40 min. the deposition virtually ceases, although not entirely.

In order to determine the uniformity of coating thickness, standard size plates of Zircaloy-2 were nickel-plated for various lengths of time in the violently agitated, boiling plating bath. Results showed the variation in the thickness over the surface to be no more than ±0·03 mil, and in most cases less.

Bright Bronze Plating

RECENT work in the laboratories of the Tin Research Institute has shown that, when bronze anodes contain certain amounts of lead, bright deposits result after a brief working-in period. The amount of lead that is necessary to give satisfactory bright deposits that are free from brittleness but retain their brightness up to a thickness of 0·003 in. to 0·004 in. (on steel) has been found to be between 0·2 and 0·4 per cent. With higher lead contents, brittleness occurs at lower thicknesses; with an anode containing 0·75 per cent lead, for instance, the limiting thickness was found to be of the order of 0·0005 in.

The tests were conducted for effective periods of between 40 and 90 amp/hr. for each litre of electrolyte and, apart from an initial working-in period of up to 5 amp/hr., the deposits remained fully bright over the whole period. Normal cathode efficiencies were obtained at 30 amp/ft², and the anode efficiencies were high; the deposits contained about 0·1 per cent lead, and were bright within the range of thickness tried (0·0001-0·015 in.).

Men and Metals

We are informed by The British Oxygen Company Limited that **Sir Owen Wansbrough-Jones,** K.B.E., C.B., has been appointed a director of the company.

An invitation from the Metal Physics Committee of the Institute of Metals to lecture on "Solidification of Alloys" has been accepted by **Dr. W. C. Winegard** (Associate Professor of Metallurgy in the University of Toronto). The lecture will be given on February 10 next year at the institute's headquarters in London.

From Atlas Copco (Great Britain) Ltd. we learn that **Mr. T. M. Horn** is retiring from the position of manager of the company's Leeds branch at the end of this year. He is being succeeded by **Mr. A. W. Tombleson,** from the Manchester branch. **Mr. W. Hossent** has been appointed manager of the new branch which is being established in Newcastle.

At the annual meeting of the Aluminium Industry Council, which was held last week, **Mr. H. G. Herrington,** C.B.E., was re-elected to serve a further term as chairman of the Council.

Chairman of Baker Perkins Limited, **Mr. A. I. Baker,** C.B.E., J.P., M.I.Mech.E., has been elected President of the British Engineers' Association. The retiring President, **Sir Edward Thompson,** J.P. (chairman and joint managing director of John Thompson Limited) has been elected honorary treasurer.

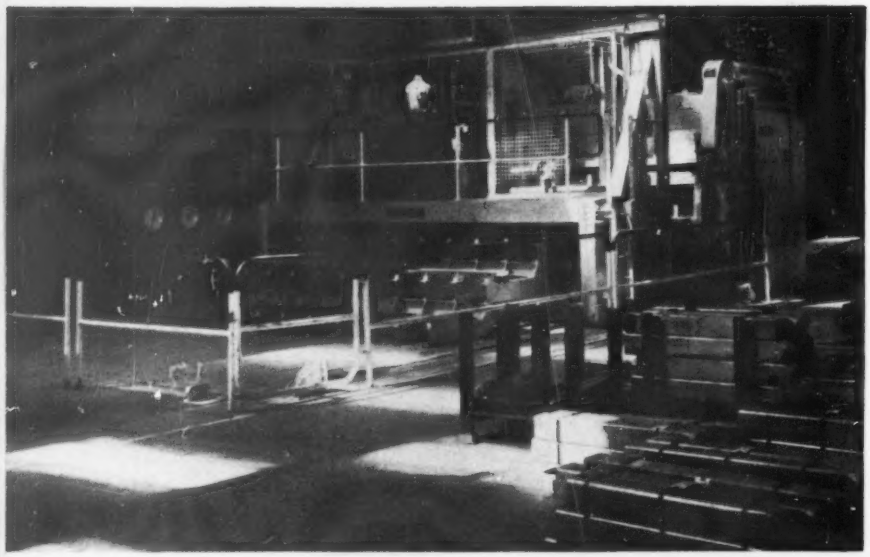
It has been announced by Efco Limited that **Mr. George B. Cooke** and **Mr. J. S. Morton** have been appointed to the board of the company.

News from Head Wrightson Processes is that **Mr. G. P. Davidson** has been appointed managing director with effect from February 1 next. The services of **Dr. R. C. Fisher,** the retiring managing director, are being retained, and he will act as advisor on nuclear research reactors and other nuclear projects.

On January 1 next, **Mr. Richard Summers,** chairman of John Summers and Sons Limited, will take office as President of the British Iron and Steel Federation.

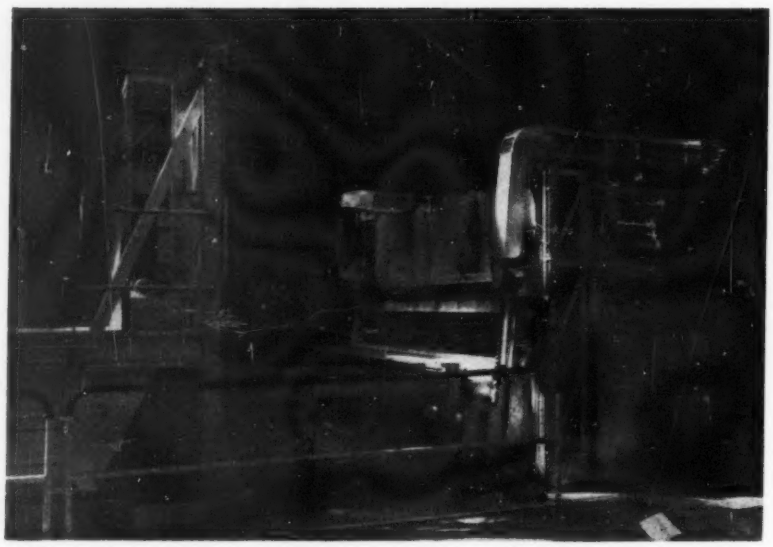
A senior lecturer in metallurgy at Birmingham College of Technology, **Dr. John C. Wright,** B.Sc., Ph.D., has been appointed Reader in Industrial Metallurgy at the college. Dr. Wright, who is 29 years of age, commenced his career as a research assistant in the Development and Research Department of the Mond Nickel Company Limited. After a year as technical officer in the Research Department of I.C.I. Metals Division, Mr. Wright became Senior Research Fellow at Wolverhampton and Staffordshire College of Technology.

Heat Treating Titanium



Above : Loading titanium rods into the G.W.B. furnace at the Waunarlwydd Works of I.C.I. Metals Division. The charging tables are visible beneath the overhanging charging machine, and in the foreground can be seen stacks of titanium billets

Below : The G.W.B. furnace with the charging machine in the quenching position



MUCH new equipment is being brought into use as the use of titanium increases. One new installation, at the Waunarlwydd Works of Imperial Chemical Industries Ltd., Metals Division, is an electric batch furnace for the treatment of titanium rod, which was designed and built by G.W.B. Furnaces Ltd., of Dudley, Worcs.

The G.W.B. furnace was designed for the annealing, hardening and tempering of titanium rod in lengths up to 12 ft. 6 in. from 0·4 in. to 2·5 in. in diameter. With a rating of 150 kW in two independent automatically controlled zones, the unit is employed for treatments within the temperature range of 800°—1150°C., varying according to the type of heat-treatment and the charge characteristics. The equipment consists of the batch furnace itself, an overhanging charging machine, traversing on rails in front of the furnace, a quench tank, a set of loading/unloading tables and the necessary instrumentation and switchgear.

The batch furnace is of the side charging type, specially designed to give maximum support to the charge, and allow speedy charging, discharging and quenching. Its effective dimensions are 12 ft. 6 in. long × 3 ft. 6 in. wide × 6 in. charge height. The furnace casing is of sheet mild steel suitably braced with strong rolled sections. A robust understructure supports the furnace clear of the ground and substantial cross-bracings are fitted at both the top and bottom of the casing. High grade refractory bricks, backed by a layer of semi-refractory insulation and a layer of insulating bricks, line the heating chamber throughout. The insulated hearth is fitted with a series of firebrick piers forming grooves for accommodating the arms of the charging machine.

To provide the heating, nickel-chromium strip heating elements are arranged in the roof and hearth of the heating chamber. Those in the roof are supported by a special hook suspension method which provides maximum support and dissipation of heat. Hearth elements are accommodated on specially shaped refractory element supports located in the hearth itself. The furnace is designed for a maximum temperature of 1150°C. The temperature uniformity achieved in a charge covering the hearth at 1000°C. was better than plus or minus 10°C. The furnace is also suitable for use at 700°C. with a maximum variation over the hearth not exceeding plus or minus 10°C. as measured by a grid of thermocouples attached to a test framework covering the maximum charge limits on the hearth.

Special attention was paid to the design of the furnace vestibule which is supported by an open channel girder at the front edge throughout the entire length, the girder being heavily gussetted and fixed to the main framework of the furnace casing. A heat-resisting material tee section is suspended from the roof cross-bracings for supporting both the rear edge of the vestibule and the arch brickwork. A drop-type, cast framed door, fully insulated and counterbalanced, is

(*Continued on page* 456)

New Plant & Equipment

Gravity Casting

USING inexpensive dies and simple in operation, a gravity die-casting machine has been introduced by the Foundry Division of Electric Resistance Furnace Co. Ltd., Netherby, Queens Road, Weybridge, Surrey.

The machine has a two-way cylinder for closing and clamping the dies, and requires only a supply of compressed air for its operation. The die heating and cooling arrangements of conventional gravity die-casting machines are not required, the dies are made in a grade of Meehanite to withstand thermal shock, and the machine is used in banks of sufficient numbers to allow time for natural cooling.

Dies are designed by the company from customers' drawings and supplied ready for insertion into the casting machine. They are made by the "true-to-form" as-cast technique at approximately one-quarter the cost of machined dies.

The "Efco" die-casting machine has an overall length of 3 ft. 10 in., is 9 in. wide, and stands at a convenient height for pouring. It will accommodate dies up to 10 in. by 8 in. in face area. A bank of five machines with gangways and stillage/bogie room occupies a floor space of about 8 ft. by 8 ft.

Sintering

FOR operation at temperatures up to 1,650°C. with a hydrogen atmosphere, a heavy duty sintering furnace has been designed and manufactured by Royce Electric Furnaces Ltd., Sir Richards Bridge, Walton-on-Thames, Surrey, for a special application.

The heating chamber is a replaceable tube of fused alumina, 5 in. inside diameter, 32 in. heated length. Fused alumina tiles housing the heavy section molybdenum heating elements surround the tube along the heated length and also support the tube, allowing free dissipation of heat and providing mechanical strength. A special high-temperature insulation of porous alumina behind the bricks is backed by graded thermal insulation, reducing heat losses to a minimum.

Failure of the work tube, due to thermal shock, or stress from the charge load does not, with this new arrangement, cause failure of the heating elements. Conversely, the work tube is unaffected by an electrical failure of the elements, which can be replaced individually in the segmental pure alumina tiles. A further advantage of this new design is that considerable sensible heat is absorbed in the refractory lining, acting as a heat reservoir. This serves to even out the heat distribution and, coupled with the mechanically strong construction, makes the furnace very suitable for heating heavy loads.

The cylindrical furnace casing is constructed of heavy gauge mild steel plate, with removable end covers, the whole being gas-tight. At the charging end, an extended solid drawn tube acts as a preheat-purging chamber; the exit chamber is water-cooled to ensure that a charge is below oxidation temperature before leaving the furnace.

Atmosphere of hydrogen or cracked ammonia is fed through an inlet under the furnace to distribution pipes in the thermal insulation in the base. The gas percolates through the insulation, absorbing heat, and is, therefore, preheated before entering the work tube. Auxiliary inlets are provided in the main furnace casing, and between heating and cooling chambers, to allow an increase in the gas flow when doors are opened for charging or discharging. A "burn-off" at both doors consumes excess hydrogen and prevents ingress of oxygen.

Heating is divided into two independent, automatically controlled zones along the length of the heating chamber. Automatic temperature control, mounted in a separate control desk, comprises three-position, indicating-type temperature controllers operating motorized voltage regulators giving stepless variation of the low voltage element supply. By this means the current is not switched off when controlling at the preset temperature.

Dust Extraction

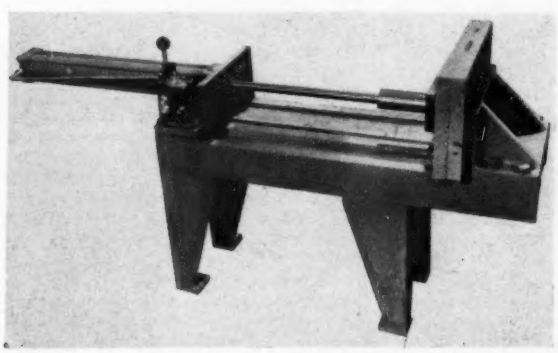
UNDER an exclusive licence arrangement, and in collaboration with the German company of Otto Hubbe, Keith Blackman Ltd., Mill Mead Road, Tottenham, London, N.17, are now manufacturing the Fischer automatic dust filter. This filter is available in two basic types, one of square section containing 24 rectangular filter "pockets" and the other of circular section containing 27 circular filter sleeves.

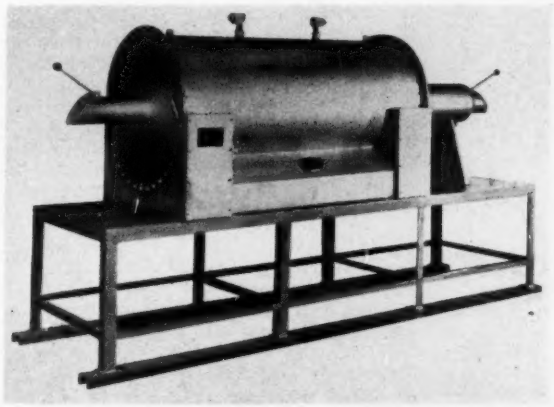
In operation the dust-laden air enters the filter and passes down into the collection hopper, where the heavy particles are settled out. The air then passes through the fabric filter pockets in the filter chamber, where the remaining dust is trapped while the clean air passes out at the clean air outlet and into the main extraction duct leading to the fan, the filter chamber always operating under suction.

For fully automatic cleaning, two or more filters are installed adjacent to one another, the number depending on the volume of air and dust passing into the filters. At predetermined intervals, which depend on the conditions under which the plant is operating, a motor-operated damper in one of the filters causes the dust-laden air to by-pass the filter, which then undergoes its cleaning cycle. This same motor simultaneously opens another damper and air is drawn

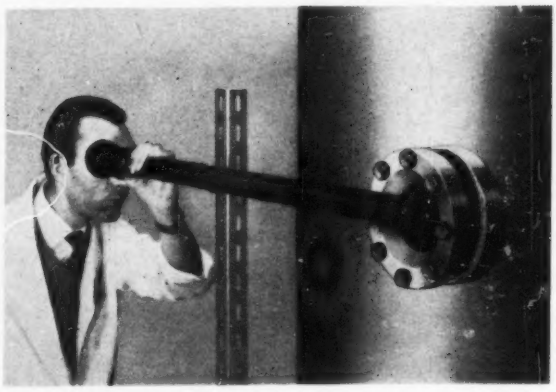
Below : The Efco gravity die-casting machine

Right : The Royce heavy duty sintering furnace





Left: The "Tornado"-Fischer automatic dust filter unit



Right: The A.201 safety periscope in use

through the purging air inlet into the filter chamber (which is under suction), passes through the pockets in the reverse direction (from outside to inside), carrying the collected dust into the main dust collection hopper, where most is deposited. The purging air then enters the inlet duct to be mixed with the dust-laden air, which is being directed to the adjacent filters which are meanwhile in normal operation.

While the reverse process is taking place, a unique high frequency vibrating mechanism agitates the pockets in a horizontal plane to dislodge the dust particles clinging to the filter bags. At no time is the filter fabric subjected to the stresses often caused by the "concertina" effect of vertical shaking gear. Thus, the "Tornado"-Fischer filter sleeves or pockets have a much longer life, reducing maintenance and replacement costs to a minimum.

Remote Viewing

A SAFETY periscope has been added to the range of remote and indirect viewing equipment made by P. W. Allen and Co., of 253 Liverpool Road, London, N.1.

This safety periscope, the Allen type A.201, is for the use of observers when closely viewing equipment and processes through sight glasses in pressure vessels, furnaces, chemical plants, etc., where danger of serious injury may arise in the event of window breakage. Using this instrument, the observer can stand well clear of the window in a safe zone and yet have his "eye" right up to the sight glass.

The Allen A.201 consists of a periscopic optical system of unit power with a field of view of 35°, fully corrected and free from distortion. The optics are contained in a metal tube 30 in. long and 1½ in. diameter, fitted at one end with a rubber eye shield and focusing sleeve, and at the other with a 90° prism. Objects between 3 in. and infinity from this prism can be focused, with great depth of focus at any setting.

A 90° eyepiece is available for use when the periscope has to be held horizontal at a level lower than the eye. Low voltage high intensity spot lights are also available to fit on the end of the periscope for use when viewing equipment inside pressure vessels which are without internal lighting.

Standard Specifications

Charpy V-notch impact test (*B.S.* 131: *Part 2*: 1959). *Price* 4*s.*

SPECIFYING the conditions for carrying out the Charpy V-notch impact test, this publication has been issued as Part 2 of the British Standard on the notched bar testing of metals.

Whereas the previous edition of the standard gave only nominal dimensions of test pieces, the new edition gives dimensions with appropriate machining tolerances. The tolerances for ferrous test pieces are in accordance with a Recommendation of the International Standards Organization, but for non-ferrous materials a more restrictive tolerance has been applied to control the dimensions of the test piece.

Three new subsidiary test pieces have been specified to replace the two specified in the previous edition and these are intended for use when it is impossible to obtain a standard test piece from the material available. Two of the sizes selected meet the particular requirements of manufacturers of tubes.

The structural and dimensional aspects of the testing machine are fully dealt with; and an appendix gives recommendations for its installation.

Copies of the above-mentioned standard may be obtained from the British Standards Institution, 2 Park Street, London, W.1.

Heat Treating Titanium—*continued from page* 454

arranged to clamp over the furnace vestibule. The clamping device employed consists of a metal buffer bar running across the outer face of the door, and attached at either end to the furnace casing. The inner face of this buffer is fitted with wedge-shaped metal sections at intervals along its length which marry up with similar wedges fitted to the outer face of the door, when the latter is in the closed position. The door driving gear consists of an electric motor transmitting through the necessary reduction and spur wheel gear to a mainshaft driving chains fitted to lugs on the door.

To give a speedy quench, the quenching tank is situated immediately in front of the furnace just below hearth level. It is a plain bosh type tank measuring approximately 15 ft. 0 in. long × 3 ft. 0 in. wide × 2 ft. 6 in. deep.

A charging machine, traversing on a set of rails is constructed to move over a set of loading tables and the quench tank in order to insert the charge into the furnace hearth. A series of fixed horizontal arms, which support the charge is arranged for insertion between the firebrick piers in the furnace hearth. When the charge, resting on the arms, is over the quench tank, ready for quenching, this portion of the machine is lowered. The vertical uprights to which the charging arms are attached are fitted with rollers riding against the fixed uprights of the machine structure. This vertical operation of the charge arm structure is effected by means of an electric motor through reduction gearing.

Instrumentation and switchgear are contained within two separate cubicles. The G.W.B. switchgear panel contains the contactors for the furnace zones, door drive motors, etc., and the other panel houses the necessary temperature control equipment. Also, adequate provision is made for the protection of the operator, charge and equipment itself.

Industrial News

Home and Overseas

Aluminium Hatch Boards

Portable hatch boards are still fitted in many ships and will probably continue to be fitted for some years to come, despite the increasing popularity of mechanically operated hatch covers. A new development is the fabrication by welding of aluminium boards for use on spans up to 8 ft. This new design, which was developed by **Northern Aluminium Company Ltd.**, has been tested to the satisfaction of the Ministry of Transport, Lloyd's Register of Shipping, and the American Bureau of Shipping, and has received their approval.

The criterion of strength for aluminium boards for 24-in. coaming hatches is that under a uniform load of 6 cwt/ft^2 the deflection shall not exceed 1/260 of the span (with a corresponding limitation on stress, depending on the alloy used), or alternatively that they shall withstand a test load of 8 cwt/ft^2 without permanent deflection. These conditions were satisfied in the tests on an 8 ft. board, which in a further test was loaded to 16 cwt/ft^2 without failure occurring. The boards were also subjected to severe impact tests by being thrown end-on from a height of about 20 ft. on to a concrete surface.

Extrusion Press Plants

During the early part of this month **Schloemann Aktiengesellschaft** organized at the works of their associated company —M.A.N., Nuremberg, an international congress devoted to "New Developments in Extrusion Press Plants". Some interesting Papers were read concerning recent progress achieved in the field of heavy press manufacture. The design and methods of operation of horizontal and vertical tube and rod presses and hydraulic stretching machines were dealt with in detail; reports were presented on new-type high-pressure reciprocating pumps and automatic press controls.

By way of supplementing these Papers dealing with the practical aspects of design advancements, information was furnished on the latest investigations carried out in the field of heavy and light metal working. Additionally, two new documentary films showed advanced design and operating techniques of vertical and horizontal extrusion presses.

Following the congress, those attending, who were mainly German and foreign manufacturers of extruded products and cables, were given the opportunity of inspecting two interesting tube and rod presses of new design in workshop assembly, and an aluminium cable sheathing press was shown in actual operation.

Packaged Oil-Gas Plants

A report from the **Incandescent Heat Company Ltd.** concerns their development of a new process for the gasification of petroleum oil. The process is continuous and does not employ catalysts. Cracking heat is supplied by burning oil and waste products in a compact and simple furnace setting. The oil to be gasified is injected together with steam into a system which is specially designed to enable a uniform and precise control of cracking temperatures to be exercised. By these means the production of unwanted by-products (particularly carbon and tarry condensates) can be kept to a minimum; more particularly the calorific value of the gas produced can be varied continuously in the range 500 to over 1,200 B.Th.U.s per cubic foot. The gas is interchangeable with natural gas or coal gas of similar calorific value. Results obtained with a heavy distillate oil indicate that this system can be operated economically over a wide range of throughputs.

New Hot Strip Mill

It has been announced that the order for the building of the 68 in. wide hot strip mill for the new Spencer works at Newport, of Richard Thomas and Baldwins Ltd., has been placed with **Davy and United Engineering Company Ltd.** The value of the contract is stated to exceed £4,000,000.

The new mill is expected to go into production in October 1961 and will have an initial output of about a million tons a year. It is, however, being designed to provide for an eventual output of around 3,000,000 tons annually.

Transportation of Plates

Interlas plate lifting clamps are now available in this country in seven different sizes to accommodate loads of 1½ tons maximum to 20 tons maximum, and plate thicknesses of ¾ in. maximum to 3 in. maximum. These clamps are ingeniously designed to lift plates or fabricated plate sections without any danger of the load slipping.

Interlas N.V. of Holland were the originators of the double-cam operated lifting clamp and the full range is now available from the British Associates, **Interlas Limited,** along with their range of clamps for horizontal lifting and transportation of plates.

Non-Ferrous Metals in India

It has been reported from New Delhi that the Indian Government has amended the non-ferrous metals control order (1958) which specifies the principles governing the issue of permits. The amendments have been published in the Gazette of India extraordinary.

In issuing permits, the controller shall have regard to (1) the requirements of the industries for a period of six months based on their consumption of non-ferrous metals in the previous year or years, (2) the requirements of small-scale industries in the states, based on the recommendations of the Development Commissioner, small scale industries, Government of India, or of the director of industry of the states, and (3) the quantity of non-ferrous metals imported and available for distribution

In a judgment delivered on December 3, 1959, the supreme court had held clause 4 of the non-ferrous metals control order (1958) to be void and pointed out that in order to make the clause effective, the principles governing the issue of permits under the order should be specified and these notified in the Gazette of India and laid before the Houses of Parliament.

Metallurgical Essay Competition

Once again the **Birmingham Metallurgical Society** announces its annual competition to students of metallurgy for the best essays on metallurgical subjects. The first prize includes the Society's medal, certificate and fifteen guineas; the second prize is a certificate and seven guineas, while the Council of the Society, at its discretion, may award additional prizes.

The competition is open to students who are more than 25 years of age and are studying, or have studied, at a technical college in Warwickshire, Worcestershire or Staffordshire, or at the University of Birmingham. Entries must be sent not later than February 6, 1960, to the secretary of the Society, c/o Brown Bayley Steels Ltd., 21 Bennetts Hill, Birmingham 2, from whom full details and conditions of the competition may be obtained.

Safety in Industry

Early in the New Year the Industrial Safety Division of the Royal Society for the Prevention of Accidents will begin its part in an international scheme intended to promote wider understanding of industrial safety and allied subjects among safety officers, works managers, industrial physicians, trade unionists and research workers.

The essential aim of this scheme is to make information available, rapidly and systematically, on literature and legislation dealing with all aspects of occupational safety and health. Every type of industrial activity will be covered, including engineering, mining and quarrying, agriculture, transport, dock work, public service and civil engineering.

Distribution of the information will be made through the International Labour Office by means of index cards. Literature to be dealt with will include reports and specialized publications of all descriptions, and books and periodicals from countries throughout the world. Laws and regulations, codes, standards, specifications, instructions and other texts of a legislative nature will also be given systematic coverage. The cards, each with a classification code number, will consist of a complete index of subjects and cross references, and each item of information will appear on only one card. Cards will be obtainable, in complete sets only, from the national organizing centre which, in Great Britain, will be the Royal Society for the Prevention of Accidents.

Complete details of this scheme may be obtained from the offices of the Society at 52 Grosvenor Gardens, London, S.W.I.

Malayan Tin

The Malayan Government has fixed the export quota for tin during the first quarter of next year at 13,590 tons—an increase of about 60 per cent over last year's figures. A Government statement said that all mines operating at any time between January 1953 and December 1957 would be allowed to resume operations "in view of the improved position". Applications for new mines would be considered, the statement added.

Control of tin exports came into force under the International Tin Agreement on December 15, 1957. Since then, tin exports from Malaya have been cut and a number of mines have had to close down. Tin mining experts described the Government announcement as "cheerful news", but did not think that there would

be a rush to open up new mines. One tin miner said: "People have become cautious. After all, nobody knows what the position will be after the first quarter. Besides, they know that as long as the international tin buffer stock is in operation prices will be kept down to a certain level. There is no quick profit in this".

A Birmingham Meeting

One of the first meetings of the **Institute of Metal Finishing** in the New Year is that of the Midland branch on January 5. This meeting will be held at the James Watt Memorial Institute, Birmingham, at 6.30 p.m., and the following Papers will be presented: "Sprayed Plastic Linings", by Mr. D. E. J. Cunningham; "Titanium in the Metal Finishing Industry", by Mr. A. Freund; and "Lead in the Plating of Chemical Plant", by Mr. G. Vestey.

Advance notice is given of the annual dinner and dance of the Midland branch, which is to be held on Friday, February 26, 1960, at the Grand Hotel, Colmore Row, Birmingham. Tickets, at 38s. 6d. each, may be obtained from Mr. J. D. Beddows, c/o Henry Wiggin and Company Ltd., 33 Newhall Street, Birmingham, 3.

Long Service

Thirty-six employees of **Northern Aluminium Company Limited** who have completed twenty-five years' service during the past twelve months were recently honoured by celebrations held at Banbury and Birmingham. At these celebrations, which were attended by Mr. B. N. H. Thornely and Mr. C. T. Cornelius, directors, and by works managers and departmental heads, the employees were warmly thanked for their long and loyal services during an important quarter-century in the life of the company. As a commemoration gift, they were offered the choice of a specially-designed aluminium clock or a gold wrist watch.

Filter for Ultrasonic Cleaners

Ultrasonic cleaning has now firmly established itself as a method of obtaining the very highest degree of cleanliness. This is particularly so where good results are costly to obtain by conventional methods, as in the horological and jewellery industries, for optical equipment and scientific instruments, on electrical, pneumatic and hydraulic gear subject to tight tolerances, on wire drawing dies and similar orifices, on filling machines of all types and in the atomic energy industry, where surfaces may be contaminated by radioactive materials.

Due to the effectiveness of ultrasonics, the cleaning solution becomes loaded with suspended dirt and has to be renewed at frequent intervals, depending on the state of the components being cleaned. Apart from the time lost in changing the solvent, the repeated renewal of solutions which are still active can be very expensive.

The type 1181 filter unit has, therefore, been introduced by **Dawe Instruments Limited** to provide for the continuous removal of solid matter from ultrasonic cleaning baths of their own or other design. Fluid is drawn from the bottom of the cleaning bath by a centrifugal pump and returned to the top of the bath by way of a filter (centre of illustration) having a robust sintered element of stainless steel, which is capable of removing all solids down to a size of below 2 microns from 8 gallons of liquid per hour. Seven coarser filter elements can be substituted to give flow rates as high as 60 gallons per hour. Changing elements either for cleaning or to obtain a different pore size is effected in less than a minute by unscrewing the cylindrical filter housing from its cap to disclose the filter element, which can then itself be unscrewed and removed. The filter housing is conveniently held in a spring clip on the wooden base board. The overall dimensions of the unit including pump and 200 W electric motor are 12 × 6½ × 10 in. high and the weight is about 15 lb.

All metal parts in contact with the cleaning fluid are of stainless steel. The interconnecting tubing is of tough, extruded nylon. All parts are thus easily cleaned and, if necessary, sterilized.

Cryogenic Equipment

It has been announced by **Research and Control Instruments Ltd.,** sole distributors in the United Kingdom, that all Philips cryogenic equipment, such as the liquid air machine, liquid nitrogen plant and cold box installation—based on the Philips' universal cooling machine—will in future incorporate improved means of starting. The characteristics of the cycle employed in the refrigeration unit are such that a relatively high torque is necessary to start the engine—this falling off as the special compressor picks up speed.

Philips have now developed a system whereby this high load on start-up is avoided. The basic principle of this system is that the compression ratio across the main piston is very much reduced during the initial few revolutions of the crankshaft by the connection of a buffer vessel to the compression space in the cylinder. A valve in the line between the two is controlled by the oil pressure in the machine and remains open until the pressure, generated by an integral pump driven from the crankshaft, reaches its normal level. This valve then closes, the compression ratio rapidly reaches its operating value, and the machine starts to run at full speed.

The duration of the idling period is sufficient to allow the motor to pick up speed under very light loading conditions and without any abnormal electrical surge. Other advantages inherent in the new system are that the special clutch and ratchet assembly, previously employed, becomes no longer necessary, a simple flexible coupling being used to connect the motor and compressor, and that the machine is now capable of restarting immediately after stopping for such applications as may require it.

High Vacuum Valves

A new type of hand-operated straight-through high vacuum valve has been announced by **Vacuum Research (Cambridge) Ltd.** Available in four sizes—1, 2, 4 and 6 inches respectively—it is a compact aluminium casting which can be used down to pressures of 10^{-6} mm. Hg Absolute. Made by Vacuum Research Co., of San Francisco, California, it is used throughout the United States and is now available from the British company.

When open, the valve disc is withdrawn completely into the valve-body to give full unobstructed passage through the valve. The valve is closed by rotating the lever through 180° and the valve plate is locked in the closed position. The valve is leak tight and can be used with atmospheric pressure on either side of the valve plate. Because the valve is very thin—the 6 in. Bore Valve measures only 4 in. across flanges—it can be used where space is limited. An air operated version is also available.

The valve is used where high conductance, or an unobstructed opening is needed e.g. with diffusion pumps, in pumping lines and vacuum locks. Special adaptor flanges can be supplied which enable the valve to be coupled to existing equipment.

Science Lecture Service

In order to promote a wider understanding and appreciation of science and of its applications in everyday life, the British Association for the Advancement of Science is establishing all over the country local committees whose first task will be to provide a popular science lecture service. This will enable organizations and societies of all kinds to secure the services of lecturers who are prepared to present science to the public as opposed to scientific and specialist groups.

The West Midlands Area Committee is already active, and has available more than a hundred lectures with titles covering many aspects of science and technology. New subjects are to be constantly added to the list. A booklet containing details of the activities of this committee is now available, and may be obtained from the Secretary, Birmingham and Midland Institute, Paradise Street, Birmingham, 1.

Trade with Iraq

For the convenience of businessmen interested in Anglo-Iraqi trade, a United Kingdom commercial office has been opened by the British Embassy in the centre of the business quarter of Bagdad. The new office, which is situated in the Ottoman Bank Building, New Bank Street, Bagdad, will function as a commercial information centre, and a complete service is available for answering commercial enquiries. There is a reading room containing a comprehensive set of trade periodicals and a library of catalogues and other commercial literature provided by United Kingdom firms.

A Birmingham Function

The first luncheon meeting in the New Year of **The Non-Ferrous Club** will be held on Wednesday, January 6, at the Queen's Hotel, Birmingham, at 12.30 p.m. At this meeting the guest speaker will be Cmdr. Douglas Lichfield-Merry, who will speak on "Reminiscences of a Naval Frogman".

Safety Notices

It is reported that in the past few years there has been a tremendous increase in the demand for safety signs and notices, and this is said to be due to the fact that industry has become considerably more safety conscious. **General Trade Equipment,** a London firm, is now marketing a full range of these notices from stock.

Distribution Rights

News from the **Birmingham Tool and Gauge Company Ltd.** is to the effect that they have now secured the sole distribution rights for the electromagnetic bench production tools manufactured by Black and Webster Ltd., of Massachusetts, U.S.A. These all-electric tools are ideal for staking, swaging, riveting, marking, etc., and the Birmingham company offers

a special tooling service to cater for assembly problems through combinations of electro-punches, rotary tables and vibratory feeds, along with the necessary special tooling, etc.

The principal tools in the range comprise the B.S. light electro-punch, giving 300 blows a minute with controlled impact; the type C 5-ton electro-punch, operating at 75 strokes a minute; the electro-punch junior, for fixed single-purpose applications; and the L T electro-tables, with 6, 8, or 12 stations, with Geneva motion, and built-in electric timer. The electro-table positions work automatically, accurately and safely, and can be arranged to trigger other tools to perform various operations and provide an ideal centre-piece for automation and low tooling costs.

Course on Materials

The Third Oxford Course of the **Purchasing Officers' Association** includes for the first time Material Study Groups (in co-operation with the British Iron and Steel Federation and the British Non-Ferrous Metals Federation) and an Operations Research Study Group.

In addition to an address by Professor R. W. Revans, B.Sc., Ph.D., Professor of Industrial Administration, Manchester College of Science and Technology, on "The Meaning of Administration", there will also be a panel discussion on "The Effect on Buying Policy and Practice of Current Restrictive Practices Legislation" between R. L. Sich, C.B.E., Registrar of Restrictive Trading Agreements, A. H. Thomas, President of Purchasing Officers' Association, and a spokesman from industry.

The Course will be held at Christ Church and Pembroke College, Oxford, from 21 to 25 March, 1960, and the fee for full-time attendance will be £25 per person. Although the Course is primarily intended for those holding senior purchasing appointments in industrial and public undertakings, other functional executives will be welcome to attend. A full programme may be obtained from: The Secretary, Purchasing Officers' Association, Wardrobe Court, 146a Queen Victoria Street, London, E.C.4.

Technical Literature

A review of technical literature including abstracts, and excerpts from articles relating to cobalt and its uses is contained in the current issue of "Cobalt", which is published by **Centre D'Information Du Cobalt,** of Brussels, Belgium. The Centre also publishes for distribution to information centres and documentation offices of industrial companies, single-sheet reprints of this literature.

International Transport of Goods

The Ministry of Transport announce a simplified Customs procedure for British road goods vehicles operating in certain European countries, which comes into force on January 7, 1960. The United Kingdom has now ratified the Customs Convention on the International Transport of Goods under cover of T.I.R. (Transport Internationale Routier) Carnets. The Convention reduces Customs formalities for road vehicles carrying goods across more than one frontier.

At present, goods being exported by road vehicles or container are always subject to examination by the Customs of the exporting country and by the Customs at each frontier crossing. For goods sent under the Convention, the Customs will normally inspect only in the countries of origin and destination, and not in other countries en route.

The T.I.R. Carnet will also serve as a bond, and the carrier will not be subject to the payment or deposit of duties en route. The countries to which United Kingdom hauliers will be able to go under T.I.R. Carnets are: Austria, Belgium, Denmark, France, Federal Republic of Germany, Italy, Luxembourg, Netherlands, Sweden and Switzerland. Particulars of the approval scheme and of the organizations authorized to issue T.I.R. Carnets can be obtained from the Ministry or from any Traffic Area Office, or from H.M. Customs and Excise, Kings Beam House, Mark Lane, London, E.C.3.

Annual Dinner

An interesting event took place on December 12 last, when the annual dinner and dance of **The International Refining Company Ltd.,** with its subsidiary companies, Maryland Alloys Ltd. and Non-Ferrous Stockholders Ltd., was held. The venue was the Swan Hotel, Stratford Broadway, London, E., and some 120 employees and guests were present. A particular significance of the occasion this year was the celebration of the company's twenty-fifth anniversary.

Forthcoming Meetings

Among the meetings of societies which will be held early in the New Year are the following:—

London Local Section of the Institute of Metals, at 17 Belgrave Square, London, S.W., on January 7—Mr. F. Kasz on "The Rolling of Aluminium".

Oxford Local Section of the Institute of Metals, at the Cadena Café, Cornmarket Street, Oxford, on January 5—Professor N. J. Petch, on "Brittle Fracture".

Leeds Metallurgical Society, on January 7—Mr. K. M. Bills, on "Modern Developments in Metallurgical Analysis".

Continuous Bright Annealing

Under this title, **Metalectric Furnaces Ltd.** are distributing a leaflet which deals with their continuous bright annealing furnaces for use with ferrous or non-ferrous metals. A number of excellent photographs accompany the details.

Import Licensing

It is reported from H.M. Embassy in Havana that import licensing requirements in Cuba have been extended to virtually all classes of goods grouped under seven categories, including metal and metal manufactures, machinery and equipment.

Headband Magnifier

In these days of intricate close work and the examination of minute detail, any magnifying unit that can be used without personal fatigue whilst leaving both hands free, is sure to meet with constant demand. Engineers, instrument and tool makers, watch makers and jewellers, printers and process engravers, surgeons, philatelists, and metallurgists are many who, during the course of their working day, use a magnifying device of some kind. **Ellis Optical Company** have designed and produced a headband magnifier which, they say, makes examination of minute detail most easy.

This headband magnifier provides magnification with good stereoscopic effect. The lenses are accurately ground with the requisite prismatic effect to prevent eyestrain, even when worn continuously. The focal distance is approximately 8 in., the field of view large, with a magnification of 2¼ times.

Constructed of a strong, lightweight plastics material, it can be worn for long periods without discomfort.

The hood, by extending over the top and side, shields the eyes from glare, whilst the object viewed may be under the most brilliant illumination. The lower side is open, allowing unrestricted downward vision, an advantage at once apparent to those using small tools, or wishing to make notes, both hands being free for this purpose. Spectacle wearers can use this magnifier without removing their glasses. The price is 36s.

Application Sheets

The Pye Applications Department has been established to help customers, old and new, who may have a problem or wish for advice on the suitability or choice of an instrument for a particular application. The Department is compiling a comprehensive reference library for the benefit of customers; part of the service they wish to give includes the issue from time to time of application sheets relating to the many and varied uses of Pye instruments.

Application Sheets on *p*H have recently been compiled and among those now in print are the following:

*p*H/4—*p*H in Nickel Plating Solutions; *p*H/5—Chrome and Cyanide Effluent Treatment; *p*H/6—*p*H Control in Ore Flotation; *p*H/7—The Importance of *p*H Control in Phosphate Chemistry; T1/1—Automatic Sulphur Determination. These sheets are supplied free of charge upon request.

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Metal Market News

EARLY last week the American Copper Institute published details of the copper statistics for November, and once again these reveal only a modest decline in stocks. The figures are given in short tons of 2,000 lb., and are as follows: inside the United States production of crude copper was 28,035 tons, against 30,792 tons in October, while the output of refined was 37,299 tons, compared with 44,218 tons. Deliveries, on the other hand, were about 15,000 tons up at 83,626 tons. Stocks of refined copper in producers' hands at 74,642 tons compared with 78,308 tons a month earlier. Outside the United States, the output of crude copper at 174,184 tons, was about 9,600 tons up on October, while in the case of refined metal the November figure of 148,619 tons compared with 137,498 tons in October. Deliveries did not show much change, for the October total of 142,297 tons was increased to 145,625 in November. Stocks of refined copper fell by about 16,300 tons to 235,859 tons. A year ago the comparative figure was 146,848 tons. The U.K. figures for October make quite a good showing, for in copper, usage was more than 2,000 tons up at 47,345 tons of refined, while scrap showed an advance from 12,189 tons to 13,756 tons. In total, October, at 61,101 tons, compared with 57,367 tons in September. Stocks were about 13,000 tons lower at 64,602 tons. In lead, consumption was about 2,700 tons up at 32,926 tons, while stocks, at 56,697 tons, compared with 63,121 at September 30. Zinc usage was somewhat lower at 30,686 tons, but stocks fell by 5,000 tons to 35,994 tons. Usage of tin was 150 tons lower at 1,948 tons, while stocks fell by 280 tons to 1,851 tons.

The feature of the copper situation last week was the announcement last Thursday that Kennecott had settled with the Mine Mill Union till mid-1961 and, naturally enough, this caused a setback in the price of standard on the Metal Exchange. Cash was done down to £249 and three months at £234 10s. 0d., but buyers appeared at these levels and values improved, to close at a rather higher level. On the whole the price remained fairly steady throughout the week, if only on account of the further drop of 400 tons in L.M.E. stocks to 5,497 tons. This is a very low figure, but there is no certainty that a further reduction will not take place, and it is difficult to see where replacements are to come from. On a turnover of about 9,500 tons, cash copper closed on Friday afternoon at £254, while three months stood at £238. These quotations showed losses of £3 and £2 for the respective positions. It is not expected that the announcement of settlements by Anaconda and Phelps Dodge will have much effect in Whittington Avenue, for Kennecott is the largest American producer, and it may well be assumed that a total settlement is already discounted in the present quotation. Indeed, it may be doubted whether we are going to see much further fall in copper, for the amount of metal lost is very great.

Tin was only moderately active, and the close of £788 for cash showed a loss of £3, while three months, at £784, was also £3 lower on balance. The improvement in U.S. consumption since the steelworkers returned has been disappointing and next year will, of course, see more tin coming along owing to the increase in the export quota. In lead, there was a turnover of 8,050 tons, December closing 27s. 6d. up at £73 2s. 6d. while March was 17s. 6d. higher at £72 12s. 6d. In the States the quotation shed ½ cent at 12½ cents. Rumours of Board of Trade releases of zinc were probably responsible for a drop of £3 in December to £94, for March was only 15s. down at £90. The turnover was 6,000 tons.

Paris

The aluminium industry in France is making great headway and official figures show that exports have increased six times since 1952. Production increased 65 per cent over the same period. It is interesting to note that while exports to foreign countries developed, those to the franc zone countries remained stationary. A new aluminium plant has just opened. It is situated at Lucé and belongs to the Aluminium Meridionale.

Many French ironmongers' shops are buying used aluminium pots and pans at around four shillings and sixpence a kilo from customers buying new aluminium pots and pans. This transaction, known as "operation aluminium" is the result of the ever increasing demand for the metal.

Péchiney and the American Dow Chemical Company have become partners in a new chemical company to be known as Plastichimie. The new company will construct plant at Robécourt. It will manufacture plastics and will not touch the non-ferrous activities of Péchiney.

Birmingham

The year goes out on a note of confidence in the Midland metal trade. Unemployment is still falling, and the region has the lowest rate in the country at only one per cent. For the first time for several years there are more vacancies for men in Birmingham than there are men out of work. At the monthly meeting of the Midland Regional Board for Industry it was stated by the chairman, Major C. R. Dibben, that production continues to rise, and the amount of slack capacity still to be utilized is small and steadily diminishing. Reports from various districts showed an increased shortage of raw materials, but up to now no sense of frustration caused on that account. The outlook was described as "set fair" with prospects of more improvements.

A lull in movement of iron and steel is expected during the Christmas holiday and the stocktaking period at the year's end. Activity is high in all branches of the iron and steel industry. Mills are better situated for orders than they have been at any time during 1959. The pressure for supplies of sheets has put a strain on the mills supplying them, but it is hoped that any shortage will be overcome in the New Year and more plant is brought into operation. The market for re-rolled steel is strong and there has been an increased demand for semi-finished material. The prosperity of the motor trade has meant steady employment for thousands of workers engaged on production of component parts including iron castings, sheets and strip. There has also been a marked revival in the market for structural steel.

New York

Commodity Exchange copper was firm over the week-end on covering and new buying reflecting, traders said, confirmed reports of a breakdown of a few furnaces at the Carteret refinery of American Metal Climax. Dealer copper was also somewhat firmer on this development, but consumer interest in copper continued quiet. Tin was quiet and steady. Lead and zinc were quiet.

From Chicago it is learned that the United Steelworkers Union and aluminium industry negotiators have reached a broadscale general agreement on a new labour contract and now are working to iron out local issues and minor disagreements. Details of the agreement are still sparse.

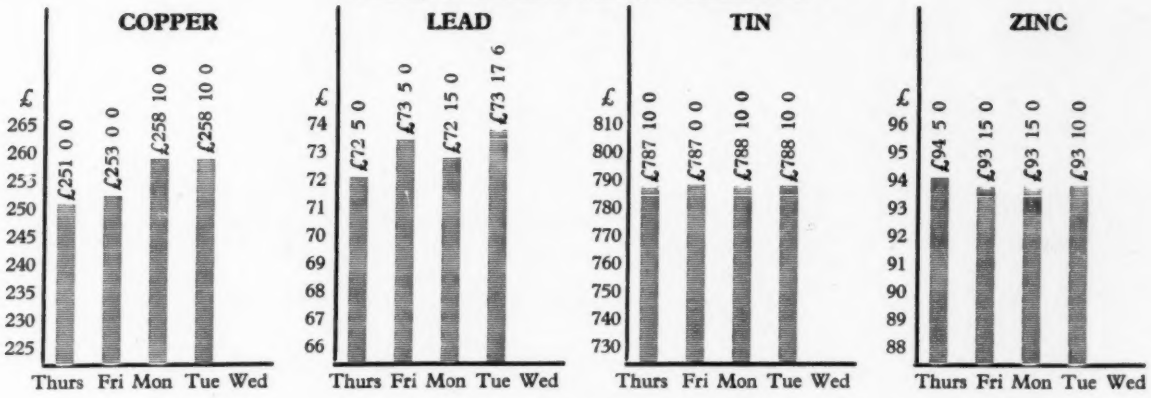
At Salt Lake City, the Kennecott Copper Corporation and representatives of the Mine Mill and Smelter Workers' Union have jointly announced an agreement on a new contract which expires on June 30, 1961. The agreement calls for a wage package of 22·3 cents per hour and fringe benefits and includes contractual provisions on work stoppages and shutdowns.

So far as the steel strike is concerned, the U.S. Government is expected to renew its mediation efforts in the dispute after a one-week lapse of meetings. The Federal Mediation Service suspended talks with the company and union representatives nearly two weeks ago. The new meetings will be the last attempt to persuade the two sides to settle before the Presidential board of enquiry enters the dispute again. The board will begin hearings on Monday next, December 28.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 17 December to Tuesday 22 December 1959



Primary Metals

All prices quoted are those available at 2 p.m. 22/12/59

		£	s.	d.
Aluminium Ingots	ton	186	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite	per unit		—	
Copper H.C. Electro	ton	258	10	0
Fire Refined 99·70%	„	257	0	0
Fire Refined 99·50%	„	250	0	0

		£	s.	d.
Copper Sulphate	ton	78	0	0
Germanium	grm.		—	
Gold	oz.	12	10	5½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	73	17	6
Magnesium Ingots	lb.		2	0
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	71	10	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	8	10	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	8½
Tellurium	lb.		18	0
Tin	ton	788	10	0
•**Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	92	7	6
Dust 95/97%	„	126	0	0
Dust 98/99%	„	132	0	0
Granulated 99+%	„	117	7	6
Granulated 99·99+%	„	134	7	6

•*Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏£/ton	**Canada** c/lb ≏£/ton	**France** fr/kg ≏£/ton	**Italy** lire/kg ≏£/ton	**Switzerland** fr/kg ≏£/ton	**United States** c/lb ≏£/ton
Aluminium		22.50 185 17 6	224 168 0	375 221 5	2.50 212 10	26.80 214 10
Antimony 99.0			230 171 10	450 265 10		29.00 232 0
Cadmium			1,300 975 0			130.00 1,040 0
Copper						
Crude				495 292 0		
Wire bars 99.9 Electrolytic	34.00 251 7 6	30.00 247 17 6	351 263 0		3.00 255 0	33.00 264 0
Lead		10.75 88 12 6	103 77 5	165 97 2 6	.91 77 7 6	13.00 104 0
Magnesium						
Nickel		70.00 578 5	900 675 0	1,200 708 0	7.50 637 10	74.00 592 0
Tin	108.25 797 0		1,101 825 15	1,500 885 0	9.75 828 17 6	99.50 796 0
Zinc						
Prime western		12 75 105 7 6				
High grade 99.95		13.35 110 5 0				
High grade 99.99		13.75 113 12 0				
Thermic			130.00 97 10 0			
Electrolytic			138.00 103 10 0	206 121 12 6	1.20 102 0	14.00 112 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 22/12/59

Aluminium Alloy (Virgin)	£	s.	d.
B.S. 1490 L.M.5 .... ton	210	0	0
B.S. 1490 L.M.6 .... „	202	0	0
B.S. 1490 L.M.7 .... „	216	0	0
B.S. 1490 L.M.8 .... „	203	0	0
B.S. 1490 L.M.9 .... „	203	0	0
B.S. 1490 L.M.10 .... „	221	0	0
B.S. 1490 L.M.11 .... „	215	0	0
B.S. 1490 L.M.12 .... „	223	0	0
B.S. 1490 L.M.13 .... „	216	0	0
B.S. 1490 L.M.14 .... „	224	0	0
B.S. 1490 L.M.15 .... „	210	0	0
B.S. 1490 L.M.16 .... „	206	0	0
B.S. 1490 L.M.18 .... „	203	0	0
B.S. 1490 L.M.22 .... „	210	0	0
Aluminium Alloys (Secondary)			
B.S. 1490 L.M.1 .... ton	172	0	0
B.S. 1490 L.M.2 .... „	185	0	0
B.S. 1490 L.M.4 .... „	192	0	0
B.S. 1490 L.M.6 .... „	200	0	0
***Aluminium Bronze**			
BSS 1400 AB.1 ..... ton		—	
BSS 1400 AB.2 ..... „		—	

*Brass	£	s.	d.
BSS 1400-B3 65/35 .. ton		—	
BSS 249 ..... „		—	
BSS 1400-B6 85/15 .. „		—	
***Gunmetal**			
R.C.H. 3/4% ton .... „			
(85/5/5/5) LG2 ..... „		—	
(86/7/5/2) LG3 ..... „		—	
(88/10/2/1) ..... „		—	
(88/10/2/½) ..... „		—	
***Manganese Bronze**			
BSS 1400 HTB1 .... „		—	
BSS 1400 HTB2 .... „		—	
BSS 1400 HTB3 .... „		—	
Nickel Silver			
Casting Quality 12% „	245	0	0
„ „ 16% „	250	0	0
„ „ 18% „	270	0	0
***Phosphor Bronze**			
B.S. 1400 P.B.1. (A.I.D. released) ..... „		—	
B.S. 1400 L.P.B.1 .... „		—	

** Average prices for the last week-end.*

Phosphor Copper	£	s.	d.
10% ..... ton	272	0	0
15% ..... „	274	0	0
Phosphor Tin			
5% ..... „		—	
Silicon Bronze			
BSS 1400-SB1 ..... „	260	0	0
Solder, soft, BSS 219			
Grade C Tinmans .... „	368	5	0
Grade D Plumbers .. „	296	10	0
Grade M ..... „	403	15	0
Solder, Brazing, BSS 1845			
Type 8 (Granulated) lb.		—	
Type 9 „		—	
Zinc Alloys			
B.S.S.1004 Alloy A .. ton	127	12	6
B.S.S.1004 Alloy B .. „	131	12	6
Sodium-Zinc ..... lb.		2	8½

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium					
Sheet 10 S.W.G.	lb.		2	8½
Sheet 18 S.W.G.	„		2	10½
Sheet 24 S.W.G.	„		3	1½
Strip 10 S.W.G.	„		2	8½
Strip 18 S.W.G.	„		2	9½
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2½
Circles 18 S.W.G.	„		3	1½
Circles 12 S.W.G.	„		3	0½
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1
Aluminium Alloys				
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3½
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2½
Strip 24 S.W.G.	„		3	10½
BS1477. HP30M.				
Plate as rolled	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9½
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0½
Strip 10 S.W.G.	„		3	10½
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9½
BS1477. HPC15WP.				
Plate heat treated..	„		6	3½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0½
BS1476. HE10WP.				
Sections	„		3	1½
Brass				
Tubes	„		2	0½
Brazed Tubes.....	„		3	2½
Drawn Strip Sections	„		3	3½
Sheet	ton	221	5	0
Strip	„	221	5	0
Extruded Bar.....	lb.		2	2½
Extruded Bar (Pure Metal Basis)	„		—	

Brass				
Condenser Plate (Yellow Metal) ..... ton	210	0	0	
Condenser Plate (Naval Brass) ..... „	222	0	0	
Wire ..... lb.		2	10½	
Beryllium Copper				
Strip ..... „	1	4	11	
Rod ..... „	1	1	6	
Wire ..... „	1	4	9	
Copper				
Tubes ..... lb.		2	5½	
Sheet ..... ton	283	0	0	
Strip ..... „	283	0	0	
Plain Plates ..... „		—		
Locomotive Rods .... „		—		
H.C. Wire ..... „	306	15	0	
Cupro Nickel				
Tubes 70/30 ..... lb.		3	8½	

Lead				
Pipes (London) .... ton	111	10	0	
Sheet (London) .... „	109	5	0	
Tellurium Lead .... „	£6 extra			
Nickel Silver				
Sheet and Strip 7% .. lb.		4	0	
Wire 10% ..... „		4	5	
Phosphor Bronze				
Wire ..... „		4	3½	
Titanium (1,000 lb. lots)				
Billet 4½" to 18" dia... lb.	54/-		55/-	
Rod ½" to 4" dia. .... „	95/-		62/-	
Wire ·036"-·232" dia. „	167/-		110/-	
Strip ·003" to ·048" .. „	200/-		75/-	
Sheet 8'×2'. 20 gauge „	85/-			
Tube, representative average gauge .... „	300/-			
Extrusions ..... „	105/-			
Zinc				
Sheet ..... ton	130	10	0	
Strip ..... „	nom.			

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 22/12/59.

Aluminium	£
New Cuttings	153
Old Rolled	138
Segregated Turnings	109
Brass	
Cuttings	175
Rod Ends	162
Heavy Yellow	131
Light	125
Rolled	165
Collected Scrap	126
Turnings	152
Copper	
Wire	228
Firebox, cut up	215
Heavy	210
Light	205
Cuttings	228
Turnings	205
Braziery	171

Gunmetal	£
Gear Wheels	185
Admiralty	185
Commercial	173
Turnings	168
Lead	
Scrap	61
Nickel	
Cuttings	—
Anodes	550
Phosphor Bronze	
Scrap	173
Turnings	168
Zinc	
Remelted	86
Cuttings	73
Old Zinc	53

Financial News

Societa Metallurgica Italiana

The annual meeting of shareholders of Italy's leading copper refinery approved the balance sheet for the year ended August 31, 1959, which showed a net profit of 593·3 million lire compared with 515·8 million in the previous year. A dividend of 190 lire per share was passed on three million shares compared with 220 lire per share paid previously on 2·4 million shares.

The Board's report said that the company's sales of rolled products had increased by 18·4 per cent during the year but difficulties had been caused by the persistent irregularity of copper prices at origin, the decline in the selling prices of the company's refined products and the need to keep part of the plant working even at a loss.

Reynolds Metal Company

It is reported from New York the Reynolds Metal Company's sales this year are expected to rise to about 480,000,000 dollars from 445,000,000 dollars last year, and earnings are expected to rise to about 40,000,000 dollars from 38,200,000 dollars in 1958, Mr. John H. Krey, vice-president, told the New York Society of Security Analysts. For the nine months ended September 30, Reynolds Metals reported sales of 366,000,000 dollars against 333,000,000 dollars the year before and earnings rose to 30,100,000 dollars from 28,100,000 dollars. Reynolds Metals is operating at about 80 per cent of capacity of 634,000 tons of primary aluminium and an additional 67,000 tons of capacity will soon be available, Mr. Krey said.

Aluminium Prices

Aluminium Limited, Canada's biggest aluminium producer and a substantial exporter to the U.S., increased its price of aluminium in the U.S. market by 1·3 cents to 26 cents per lb, effective December 19 last. The announcement states the new price is for its 99½ per cent minimum purity ingot. Price adjustments also will be made for alloys and other primary products. This follows an increase of three-quarters of a cent made in Aluminium's other markets on December 16 and follows the 1·3 cents increase of U.S. producers.

William E. Dunn

Group net profit year ended September 30, 1959, £82,480 (£70,672) and dividend on doubled capital 12½ per cent (6¼ per cent equivalent). Fixed assets £323,343 (£321,709) and net current assets £240,086 (£188,363). Commitments £110,000 (nil).

New Companies

The particulars of companies recently registered are quoted from the daily register compiled by Jordan and Sons Limited, Company Registration Agents, Chancery Lane, W.C.2.

Scrap Metals and Residues Limited (641393), 4 Gosta Green, Birmingham. Registered November 6, 1959. Nominal capital, £100 in £1 shares. Directors: David Gerzon and Stephen Southall.

Thursfield Plating Co. Limited (641460), 14-18 High Holborn, W.C.1. Registered November 6, 1959. To carry on business of electro, nickel and chromium platers, etc. Nominal capital, £1,000 in £1 shares. Directors: John R. Thursfield, Richard Chapman and John G. Thursfield.

Copal Foundries Limited (641622), Pikehelve Street, West Bromwich. Registered November 10, 1959. Nominal capital, £5,000 in £1 shares. To carry on business of manufacturers of and dealers in aluminium, iron, steel, etc. Directors: Anthony R. Ford and Douglas J. H. Turner.

T.E. Construction Limited (641805), St. Andrew's House, 32 Holborn Viaduct, E.C.1. Registered November 11, 1959. To carry on business of consultants, designers, erectors of components and structures in timber and timber by-products, ferrous and non-ferrous metals, etc. Nominal capital, £500 in 1s. shares. Directors: Wm. H. Willatts and Mrs. F. H. Willatts.

Liquid Metal Applicators Limited (641880), 129 Mottingham Road, Mottingham, S.E.9. Registered November 12, 1959. Nominal capital, £100 in £1 shares. Directors: Dennis G. Cox and Mrs. Hilda M. Ritson.

E. and E. Slater (Oldham) Limited (642679), 143 Boundary Park Road, Chadderton, Oldham. Registered November 23, 1959. To carry on business of machinery and metal merchants, marine store dealers, etc. Nominal capital, £500 in £1 shares. Directors: Edmund Slater, Edith Slater and Roy White.

Trade Publications

Salamander Plumbago Stoppers and Nozzles. — The Morgan Crucible Company Ltd, Battersea Church Road, London, S.W.11.

This company has just produced a leaflet, in colour, descriptive of their Salamander plumbago stoppers and nozzles, with photographs and diagrams.

Aluminium Products. — Imperial Aluminium Company Ltd., P.O. Box 216, Witton, Birmingham, 6.

This twelve-page brochure illustrates some of the many applications for which aluminium extrusions from "Impalco" Waunarlwydd works are being used. Details are given of a wide range of extruded and drawn products. Many bars and sections are available from stock.

A Heat and Vapour Seal.—The Pyrene Company Ltd., Metal Finishing Division, Great West Road, Brentford, Middx.

In their latest sales information bulletin this company draws attention to their "Heat-Lok" heat and vapour seal for hot processing baths. This is stated to be a new treatment which provides a protective chemical blanket for hot immersion processing baths. The treatment consists of two integral components—the "Heat-Lok" sealant, forming a protective blanket on the surface of the processing bath, and the "Heat-Lok" additive, which is a surface activating agent in the processing solution itself. The firm states that this treatment has no harmful effect on the coating characteristics of the processing solution; in fact, it frequently increases the efficiency of the process, tending to produce more complete and uniform coatings.

Brightray Coated Valves.—Henry Wiggin and Company Ltd., Wiggin Street, Birmingham, 16.

The excellent resistance to corrosion by the products of combustion of leaded fuels offered by the 80 : 20 nickel-chromium alloy manufactured by this company, is the subject of a brochure just issued. The technique of applying the protective coating of B.A.C. Brightray nickel-chromium heat-resisting alloy to exhaust valves is fully explained with illustrations in this brochure. It also shows how this material is used to reclaim burnt-out valves.

Timing Belts.—Crofts (Engineers) Ltd., Thornbury, Bradford, 3.

A new catalogue has been issued dealing with this company's ½ in. pitch range of PowerGrip timing belts. Statistical data, diagrams and photographs accompany the details.

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

France (francs per kilo):

Electrolytic copper scrap	(£219.0.0)	292
Heavy copper	(£219.0.0)	292
No. 1 copper wire	(£210.0.0)	280
Brass rod ends	(£150.0.0)	200
Zinc castings	(£67.12.6)	90
Lead	(£64.12.6)	86
Aluminium	(£135.0.0)	180

Italy (lire per kilo):

Aluminium soft sheet clippings (new)	(£200.15.0)	340
Lead, soft, first quality	(£80.17.6)	137
Lead, battery plates	(£45.10.0)	77
Copper, first grade	(£236.0.0)	400
Bronze, commercial gunmetal	(£183.0.0)	310
Brass, heavy	(£162.5.0)	275
Brass, light	(£147.12.6)	250
Brass, bar turnings	(£150.10.0)	255
Old zinc	(£54.5.0)	92

Japan (Yen per metric ton):

Electrolytic copper	(£—)	343,000
Copper wire No. 1	(£—)	295,000
Copper wire No. 2	(£—)	250,000
Heavy copper	(£—)	295,000
Light copper	(£—)	240,000
Brass, new cuttings	(£—)	210,000
Red brass scrap	(£—)	223,000

West Germany (D-marks per 100 kilos):

Used copper wire	(£219.0.0)	250
Heavy copper	(£219.17.6)	252
Light copper	(£175.5.0)	200
Heavy brass	(£131.10.0)	150
Light brass	(£100.15.0)	115
Soft lead scrap	(£57.10.0)	65
Zinc scrap	(£48.2.6)	55
Used aluminium unsorted	(£105.2.6)	120

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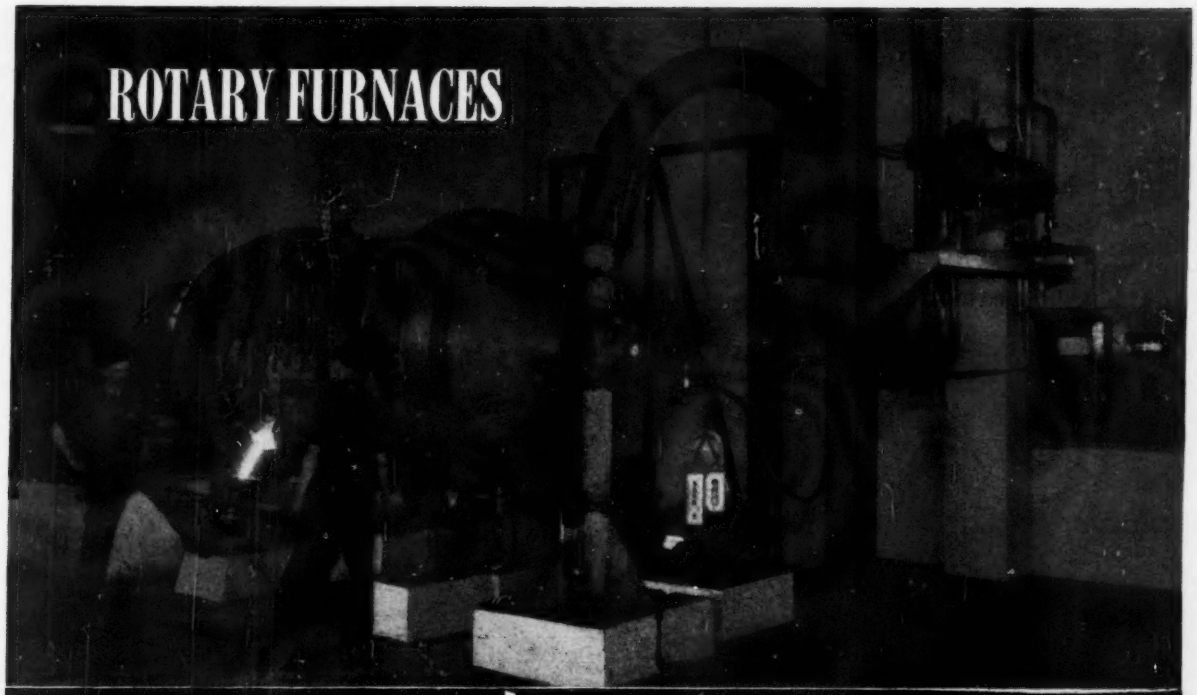
ISSUED CAPITAL •	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 21 DECEMBER +RISE — FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	31/3	9	9	5 15 3	33/3	23/3	24/9	17/6
400,000	2/–	Anti-Attrition Metal	1/3	4	8½	6 15 0	1/6	1/3	1/9	1/3
41,303,829	Stk. (£1	Associated Electrical Industries ...	58/9 —1/3	15	15	5 5 9	67/–	54/–	58/9	46/6
1,613,280	1	Birfield	66/6 +1/–	15	15	4 10 3	75/–	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	73/3xcap +3/6	20B	17½	3 12 9	74/–	48/–	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	67/– —1/9	12½	11	3 14 6	68/9	36/1½	39/–	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/9	5	5	6 7 0	16/3	15/–	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	20/–	6	6	6 0 0	20/–	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	45/–	10	10	4 9 0	45/–	27/6	28/9	24/–
300,000	1	Ditto Pref. 5%	15/–	5	5	6 13 3	15/6	14/–	16/–	15/–
160,000	1	Booth (James) & Co. Cum. Pref. 7%	21/– +3d.	7	7	6 13 3	21/–	20/–	20/4½	19/–
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	20/9	6	6	5 15 9	20/9	18/9	20/–	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	57/3 +1/–	12½	12½	4 7 3	61/–	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	79/– —6d.	10	10	2 10 9	79/6	49/3	52/–	28/3
1,200,000	Stk. (5/–)	Canning (W.) & Co.	15/10½ —1½d.	25+ *2½C‡	25	3 18 9	16/9	12/3	25/3	19/3
60,484	1/–	Carr (Chas.)	2/1½	12½	25	5 17 9	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	28/–	10H	10	7 2 9	28/–	22/6	22/–	16/–
45,000	1	Ditto Cum. Pref. 6%	16/9	6	6	7 3 3	17/–	15/3	16/–	15/–
250,000	2/–	Coley Metals	3/9	15	20	8 0 0	4/–	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	75/9 +6d.	15	18¾	3 19 3	76/–	59/–	65/3	41/–
1,509,528	1	Davy & United	111/9 +6d.	30‡	20	2 13 9	113/3	43/1½	87/–	45/9
6,840,000	5/–	Delta Metal	24/9 —3d.	31‡	30	3 2 9	26/6	12/–	25/–	17/7½
5 296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	55/9 +2/3	15	12½	5 7 6	60/–	36/7½	38/–	22/9
750,000	1	Evered & Co.	42/6 +6d.	10§	15D	4 14 0	42/6	30/–	30/–	26/–
18,000,000	Stk. (£1)	General Electric Co.	42/9	10	10P	4 13 6	48/9	30/–	40/6	29/6
1,500,000	Stk. (10/–)	General Refractories Ltd.	45/–	20	20	4 9 0	46/3	31/9	39/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	66/–	16½	15	5 0 0	67/–	63/–	67/6	61/–
750,000	5/–	Glacier Metal Co. Ltd.	11/6 +9d.	11½	11½	5 0 0	11/6	6/7½	8/3	5/–
1,750,000	5/	Glynwed Tubes	25/6 +1½d.	20¶	20	3 18 6	26/3	16/3	18/1½	12/10½
5,421,049	10/–	Goodlass Wall & Lead Industries ...	50/– +1/6	13‖	18D	2 12 0	50/–	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	117/6	30	20	5 2 0	117/6	75/–	57/9	45/–
396,000	5/–	Harrison (B'ham) Ord.	26/– +6d.	*17½	*15	3 7 3	26/3	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6	7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/–	Heenan Group	16/– +3d.	15	10	4 13 9	16/–	7/6	9/7½	6/9
246,209,422	Stk. (£1)	Imperial Chemical Industries ...	58/– +1/3	12 DZ	10	2 15 3	58/9	33/9	38/–	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	17/6	5	5	5 14 3	18/10½	16/–	17/1½	16/–
14,584,025	**	International Nickel	199	$3	$2.60	2 14 6	199	154½	169	132½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3	5	5	6 3 0	16/3	15/4½	16/9	15/–
6,000,000	1	Ditto Ord.	49/3 +9d.	12D	10	3 5 0	49/3	29/7½	47/–	36/6
600,000	10/–	Kenn Blackman	32/6	17½E	15	5 7 9	33/9	25/–	28/9	15/–
320,000	4/-	London Aluminium	7/10½ +3d.	10	10	5 1 6	8/3	5/3	6/–	3/–
765,012	1	McKechnie Brothers Ord.	62/6 +1/–	15F	15	4 16 0	63/9	41/–	45/–	32/–
1,530,024	1	Ditto A Ord.	60/6	15F	15	4 19 3	62/–	38/9	45/–	30/–
1,108,268	5/–	Manganese Bronze & Brass	15/6	20§	20	6 14 5	18/6	13/9	14/1½	8/9
50,628	6/–	Ditto (7½% N.C. Pref.)	6/3	7½	7½	7 4 0	6/3	6/-	6/3	5/6
13,098,855	Stk. (£1)	Metal Box	75/9 —9d.	11	11	2 18 0	80/–	44/7½	73/3	40/6
415,760	Stk. (2/–)	Metal Traders	9/6	50	50	10 10 6	12/3	8/4½	9/–	6/3
160,000	1	Mint (The) Birmingham	34/6 —6d.	10	10	5 16 0	35/–	22/–	22/9	19/–
80,000	5	Ditto Pref. 6%	80/	6	6	7 10 0	80/–	69/–	83/6	69/–
5,187,938	Stk. (£1)	Morgan Crucible A	49/6 —6d.	10¢	10	2 17 9	51/6	30/7½	45/–	34/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/6	5½	5½	5 19 0	18/6	17/6	18/–	17/–
2,200,000	Stk. (£1)	Murex	67/– +3/–	15	17½	4 9 6	69/6	41/–	58/9	46/–
468,000	5/–	Ratcliffs (Great Bridge)	13/6	10R	10	2 15 6	13/6	9/6	11/1½	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	55/–	25	20	4 11 0	55/–	27/9	27/3	24/6
3,400,500	Stk. (5/–)	Serck	20/4½xcap —4½d	17½GB	15	2 17 3	30/9	18/–	18/7½	11/–
6,698,586	Stk. (£1)	Stone-Platt Industries	58/9 —9d.	15	15	5 2 3	63/–	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	18/3 +3d.	5½	5½	6 0 6	18/3	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord.	123/6	20	17½	3 2 3	129/6	72/–	86/–	48/4½
41,000,000	Stk. (£1)	Vickers	34/–	10	10	5 17 9	37/–	27/4½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	16/6 +6d.	5	5	6 1 3	16/6	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6 —1/6	*5	*5	6 12 3A	24/-	20/6	23/–	21/3
2,200,000	1	Ward (Thos. W.), Ord.	157/6 +2/6	25	20	3 3 6	159/9	83/–	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	55/6	10	10	3 12 0	56/6	39/9	46/6	32/6
225,000	2/–	Wolverhampton Die-Casting ...	12/6 +3d.	30	30	4 16 0	13/3	8/8½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	32/3 —7½d.	27½	27½	4 5 3	34/–	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	8/–	20	20	6 5 0	8/–	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	14/3	6	6	8 8 6	13/9	12/10½	13/–	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/7½	27	40D	7 9 0	3/9½	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% capitalized issue. •The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. D And 50% capitalized issue. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/– Stock Units. ¶ Interim since increased from 10% to 12%. ¢ And 40% capitalized issue. Z Interim since increased. B And 50% capitalized issue. G And 1½d. special distribution. F And special 5% tax free dividend. H And Capital Dividend of 7½%.



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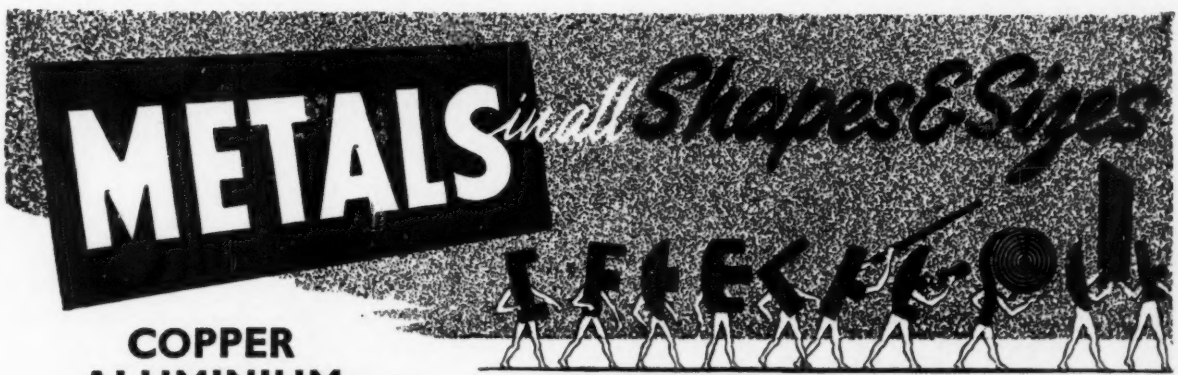

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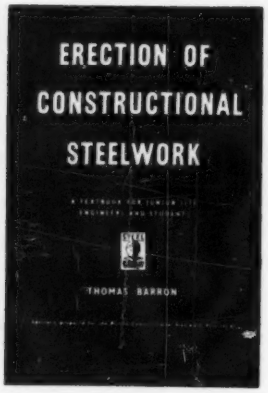

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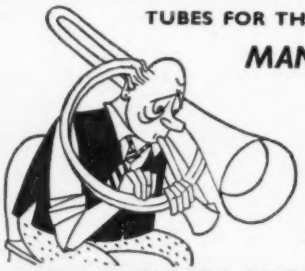

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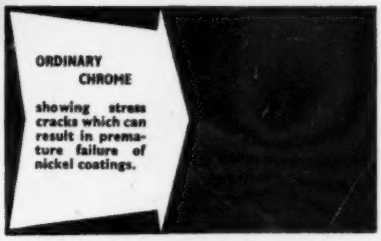

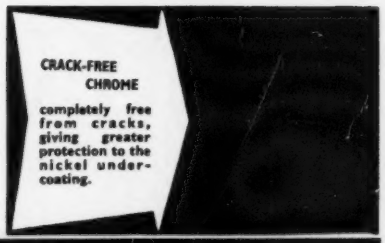

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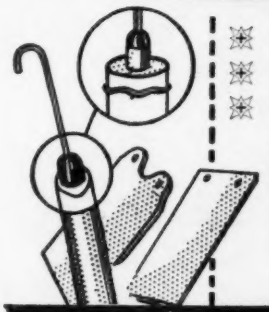

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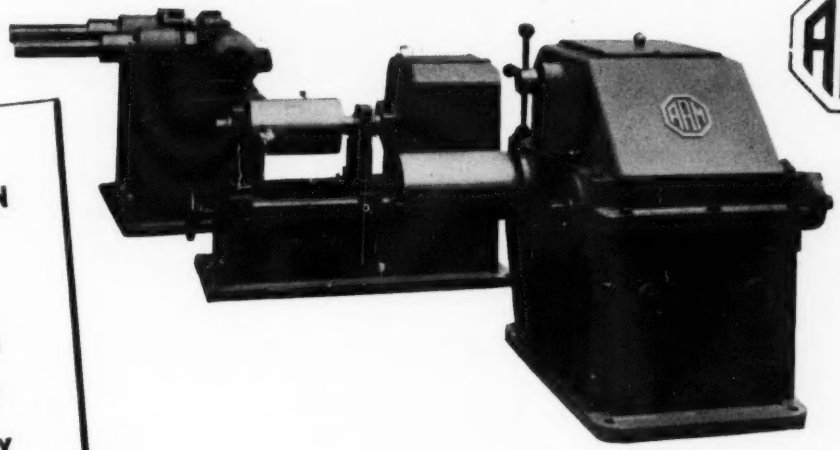

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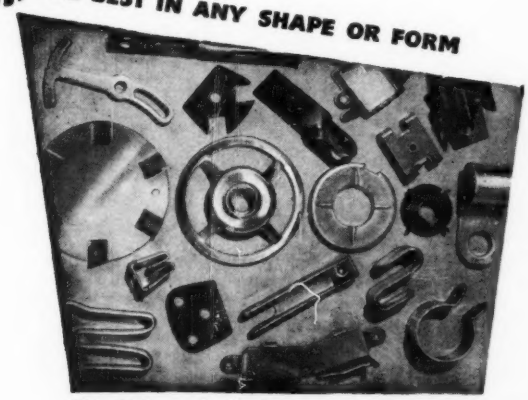

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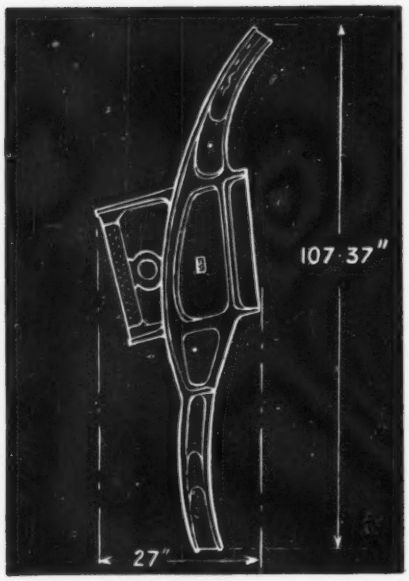

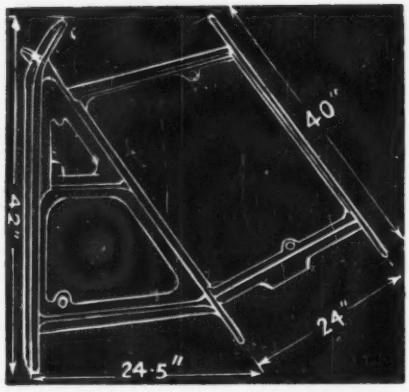

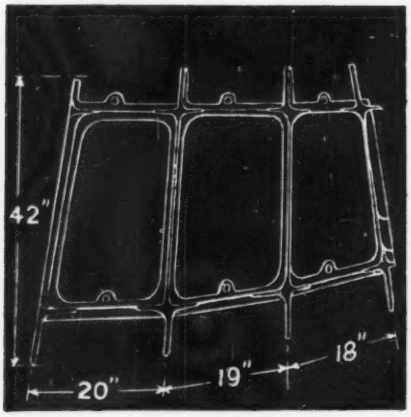

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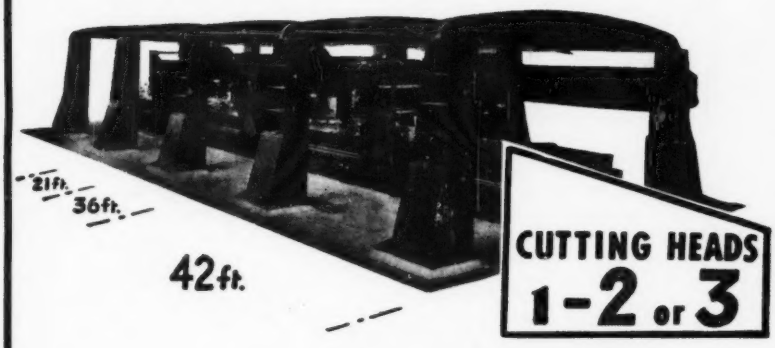

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